MARKED-UP VERSION OF

SUBSTITUTE SPECIFICATION

SPECTACLE AND CONTACT LENS SELECTING SYSTEM AND METHOD THEREOF

BACKGROUND OF THE INVENTION

5   1.   Field of the Invention

        The present invention relates to a spectacle and contact

    lens selecting system and a method thereof, and in particular,

    to a spectacle and contact lens selecting system and a method

    thereof, which enable the selection of spectacles and contact

10 lenses fitted to each person on a computer network.

    2.   Description of the Related Art

        Conventionally known ~~as means~~ methods for selecting

    spectacles lenses are methods which utilize eyeball models. ~~As~~

15 ~~the~~ Well known eyeball models~~, well known~~ are the Gullstrand

    eyeball model and the Le-Grand eyeball model.

        These eyeball models have been used entirely for the

    design and evaluation of spectacles lenses. For the design of

    spectacles lenses, one standard model prepared as an optical

20 eye model would make it possible to design lenses having

    various powers for standard eyes. This is sufficient~~ly enough~~

    for the design irrespective of the eye structure of a person

    because he/she can select among spectacles lenses prepared in

    every power of 0.25D by actually wearing them, thereby

25 ensuring that he/she finds spectacles lenses suitable for

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correction. That is, ~~there~~selection is ~~a flexibility of selection~~flexible.

~~These days~~ Currently, on the other hand, to measure uncorrected or corrected vision, one goes to see an

5   ophthalmologist or has his/her vision measured at spectacles shops using ~~their~~optometers.

Recently, for example, virtual malls are available over networks such as the Internet~~, however, any~~. However, none of the spectacles shops available in these virtual malls provides

10 ~~no~~a system for measuring the uncorrected and corrected vision on an on-line basis.

However, to solely determine the power of spectacles lenses suitable for the eyes of an individual, an optical model such as the eyeball model assumed to be commonly

15 applicable to everyone would cause significant error in optical calculation thereby making the determination impossible. The determination can be made only by constructing an eyeball model for each person.

~~Using~~Use of the conventional eyeball models~~, as they are,~~

20 will ~~raise~~create the following problems. ~~That is,~~

· Since the conventional eyeball model is based on measurements made on eyes of people from Europe and the United States, they cannot be used for constructing a model having values close to those obtained by measuring living eyes of other races, e.g.,

25 Japanese people. For example, Japanese have a smaller radius

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of curvature of the cornea than do people from Europe and the
United States.

· A model is prepared based on an average of measurements.

Literatures show Literature shows that in such data that, the depth of the anterior chamber of the eye varies with age
or the length of the eye axis is correlated with the degree of
myopia for low degrees of shortsightedness. Thus, it is
apparently necessary to construct an eyeball model according
to the age and the degree of myopia of each individual.

· Although the lens of the eye has a refractive index that is
unevenly distributed, the average refractive index is used.
The simplified double structure provided to the lens of the
eye causes a significant error in tracking rays of light.

On the other hand, where difficulty is found in visiting
medical care providers or spectacles shops such as due to the
time required and the distance traveled for the visit, there
has been a need for implementing a system which enables one to
remotely measure his/her vision over the Internet.

In particular, one's currently wearinga person's current
spectacles or contact lenses may provide more blurred viewing
than before.no longer properly correct their vision. In this
case, it would be very convenient if one can to remotely
measure his/her uncorrected and corrected vision in order to
determine whether he/she needs to buy new spectacles or
contact lenses.

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Moreover, if a user can see himself/herself wearing
spectacles or contact lenses ~~at the selection of~~when selecting
spectacles or contact lenses, the selection of spectacles or
contact lenses ~~can be further ensured with increased~~

5   ~~facilitation.~~

~~It~~is ~~therefore a principal object of the present~~
~~invention to provide a system and method for determining an~~
~~spectacles/contact lens power suitable for an individual, and~~
~~for confirming wearing condition.~~facilitated.

10 ~~----~~

                    SUMMARY OF THE INVENTION

~~A spectacle and contact lens selecting system set~~
~~forth in claim 1 of the present invention, comprises: input~~
~~means for inputting information related to~~To overcome the

15 problems described above, preferred embodiments of the present
invention provide a system and method for determining a
spectacles/contact lens power suitable for an individual, and
for confirming wearing condition.

      A spectacle and contact lens selecting system according

20 to a ~~state~~preferred embodiment of the present invention
includes an input unit for inputting information related to
the condition of the eyes of a user~~,~~, an eyeball optical
model deciding ~~means~~unit for deciding an eyeball optical model
corresponding to the information related to the ~~state~~condition
25 of the eyes input by the input ~~means,~~unit, an eyeball

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accommodation range determination ~~means~~unit for examining
optical performance of an eyeball within a range of
accommodation of the user in the eyeball optical model decided
by the eyeball optical model deciding ~~means~~unit to determine

5 the range of accommodation of the eyeball~~,~~, a lens power
selecting ~~means~~unit for examining optical performance when the
user wears spectacles or contact lenses to select a lens
power~~,~~, and a wearing state display ~~means~~unit for generating
and displaying a wearing state of the spectacles or the

10 contact lenses to be selected.

~~The~~In the spectacle and contact lens selecting system~~
set forth in claim 2 of the present invention~~, the input unit
is ~~recited in claim 1, wherein the input means is~~preferably
configured so as to allow the user to input information

15 ~~of~~about the eyes of the user, such as a wearing condition of
the user, an age, a near point distance, a far point distance,
or a vision at a constant distance.

~~The~~In the spectacle and contact lens selecting system~~
set forth in claim 3 of the present invention is recited in~~

20 ~~claim 1 or 2, wherein,~~ the eyeball optical model deciding
~~means comprises~~unit preferably includes a start eyeball
optical model deciding ~~means~~unit for deciding a start eyeball
optical model based on the information ~~of~~about the eyes of the
user, such as an age and an approximated lens power.

25 ~~The~~In the spectacle and contact lens selecting system

5

set ~~forth in claim 4 of the present invention is recited in~~
~~any one of claims 1 to 3, wherein,~~ the eyeball optical model
deciding ~~means is~~is preferably configured ~~so~~such that at
least one of a focal state in the eyeball of the user at an
accommodation midpoint calculated from a near point distance
and a far point distance of the user ~~becomes optimal~~and/or a
focal state in the eyeball of the user in a non-accommodative
state calculated from the far point distance of the user
~~becomes optimal~~is optimized.

The spectacle and contact lens selecting system ~~set forth~~
~~in claim 5 of the present invention is recited in any one of~~
~~claims 1 to 4,~~preferably further ~~comprising~~includes an
eyeball optical model validity examination ~~means~~unit for
examining the validity of the eyeball optical model at a limit
of accommodation on at least one of a near point side and~~/or~~
~~on~~ a far point side.

~~The~~In the spectacle and contact lens selecting system~~—~~
~~set forth in claim 6 of the present invention is recited in~~
~~any one of claims 1 to 5, wherein,~~ the eyeball accommodation
range determination ~~means is~~unit is preferably configured to
~~be able to~~determine a range of accommodation of optical
dimensions of the eyeball at an accommodation midpoint.

The spectacle and contact lens selecting system ~~set forth~~
~~in claim 7 of the present invention is recited in any one of~~
~~claims 1 to 6,~~preferably further ~~comprising~~includes an eyeball

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optical model image generating ~~means~~unit for generating and

displaying an image of an eyeball optical model in which the

range of accommodation of the eyeball is determined.

5   The spectacle and contact lens selecting system ~~set forth~~

~~in claim 8 of the present invention is recited in any one of~~

~~claims 1 to 7,~~preferably further ~~comprising~~includes an

eyeball optical model focal performance examination ~~means~~unit

for examining focal performance of the eyeball optical model

at a near point or a position within a range of accommodation

10   ability in the vicinity of the near point, at a far point or a

position within the range of accommodation ability in the

vicinity of the far point, or at a position away from the near

point and the far point in a naked eye state of the user.

      ~~The~~In the spectacle and contact lens selecting system

15   ~~set forth in claim 9 of the present invention is recited in~~

~~claim 8, wherein,~~ the eyeball optical model focal performance

examination ~~means comprises means~~unit preferably includes a

unit for examining a focal state of the eyeball optical model

of the user at the near point or the position within the range

20   of accommodation ability in the vicinity of the near point, at

the far point or the position within the range of

accommodation ability in the vicinity of the far point, or the

position away from the near point and the far point after

vision correction with the spectacles or the contact lenses.

25   The spectacle and contact lens selecting system ~~set forth~~

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~~in claim 10 of the present invention is recited in any one of~~ ~~claims 1 to 9,~~preferably further ~~comprising~~includes a sharpness score generating ~~means~~unit for generating a visibility sharpness score of ~~visibility of~~the user at at least one of before and ~~/or~~ after vision correction with the spectacles or the contact lenses.

The spectacle and contact lens selecting system ~~set forth~~ ~~in claim 11 of the present invention is recited in any one of~~ ~~claims 1 to 10,~~preferably further ~~comprising~~includes a viewed image generating ~~means~~unit for generating an image to be viewed by the user at at least one of before and ~~/or~~ after vision correction with the spectacles or the contact lenses.

~~The spectacle and contact lens selecting system set forth~~ ~~in claim 12 of~~In the ~~present invention is recited in any one~~ ~~of claims 1 to 11, wherein~~spectacle and contact lens selecting system set, the wearing state display ~~means comprises:~~unit preferably includes an image acquisition ~~means~~unit for acquiring an image of the user~~,~~ and an image synthesizing ~~means~~unit for synthesizing an image of spectacles or contact lenses to be selected and the acquired image of the user.

A spectacle and contact lens selecting method ~~set forth~~ ~~in claim 13~~according to another preferred embodiment of the present invention~~, comprises~~ includes the steps of~~:~~ inputting information related to a state of eyes of a user~~,~~ deciding an eyeball optical model corresponding to the information related

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to the state of the eyes input by the input step~~,~~ examining

optical performance of an eyeball within a range of

accommodation of the user in the eyeball optical model decided

by the step of deciding the eyeball optical model, to

5   determine the range of accommodation of the eyeball~~,~~

examining optical performance when the user wears spectacles

or contact lenses to select a lens power~~,~~ and generating and

displaying a wearing state of the spectacles or the contact

lenses to be selected.

10   ~~The spectacle and contact lens selecting method set forth~~

~~in claim 14 of~~In the ~~present invention is recited in claim 13,~~

~~wherein~~spectacle and contact lens selecting method, the input

step ~~comprises~~preferably includes the step of inputting

information ~~of~~about the eyes of the user, such as a wearing

15   condition of the user, an age, a near point distance, a far

point distance, or a vision at a constant distance.

        ~~The spectacle and contact lens selecting method set forth~~

~~in claim 15 of~~In the ~~present invention is recited in claim 13~~

~~or 14, wherein~~spectacle and contact lens selecting method, the

20   step of deciding the eyeball optical model ~~comprises~~preferably

includes the step of deciding a start eyeball optical model

based on the information of the eyes of the user, such as an

age and an approximated lens power.

        ~~The spectacle and contact lens selecting method set forth~~

25   ~~in claim 16 of~~In the ~~present invention is recited in any one~~

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~~of claims 13 to 15, wherein~~spectacle and contact lens
selecting method, the step of deciding the eyeball optical
model ~~comprises~~preferably includes the step of deciding the
eyeball optical model ~~so~~such that at least one of a focal

5   state in the eyeball of the user at an accommodation midpoint
calculated from a near point distance and a far point distance
of the user ~~becomes optimal~~and/~~or~~ a focal state in the
eyeball of the user in a non-accommodative state calculated
from the far point distance of the user ~~becomes optimal~~is

10   optimized.

The spectacle and contact lens selecting method ~~set forth~~
~~in claim 17 of the present invention is recited in any one of~~
~~claims 13 to 16,~~preferably further ~~comprising~~includes the step
of examining validity of the eyeball optical model at a limit

15   of accommodation on at least one of a near point side and/~~or~~
~~on~~ a far point side.

~~The~~In the spectacle and contact lens selecting method~~-~~
~~set forth in claim 18 of the present invention is recited in~~
~~any one of claims 13 to 17, wherein,~~ the step of determining

20   the range of accommodation of the eyeball ~~comprises~~preferably
includes the step of determining a range of accommodation of
optical dimensions of the eyeball at an accommodation midpoint.

The spectacle and contact lens selecting method set ~~forth~~
~~in claim 19 of the present invention is recited in any one of~~

25   ~~claims 13 to 18,~~preferably further ~~comprising~~includes the step

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of generating and displaying an image of an eyeball optical model in which the range of accommodation of the eyeball is determined.

The spectacle and contact lens selecting method ~~set forth~~

5 ~~in claim 20 of the present invention is recited in any one of~~ ~~claims 13 to 19,~~preferably further ~~comprising~~includes the step of examining focal performance of the eyeball optical model at a near point or a position within a range of accommodation ability in the vicinity of the near point, at a far point or a

10 position within the range of accommodation ability in the vicinity the far point, or at a position away from the near point and the far point in a naked eye state of the user.

~~The~~In the spectacle and contact lens selecting method~~set forth in claim 21 of the present invention is recited in~~

15 ~~claim 20, wherein,~~ the step of examining the focal performance of the eyeball optical model ~~comprises~~preferably includes the step of examining a focal state of the eyeball optical model of the user at the near point or the position within the range of accommodation ability in the vicinity of the near point, at

20 the far point or the position within the range of accommodation ability in the vicinity of the far point, or at the position away from the near point and the far point after vision correction with the spectacles or the contact lenses.

The spectacle and contact lens selecting method ~~set forth~~

25 ~~in claim 22 of the present invention is recited in any one of~~

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~~claims 13 to 21,~~preferably further ~~comprising~~includes the step

of generating a visibility sharpness score of ~~visibility of~~

the user at at least one of before and~~/or~~ after vision

correction with the spectacles or the contact lenses.

The spectacle and contact lens selecting method ~~set forth~~

~~in claim 23 of~~preferably further includes the step of

generating an image to be viewed by the user at at least one

of before and after vision correction with the spectacles or

the contact lenses.

In the ~~present invention is recited in any one of claims~~

~~13 to 22, further comprising the step of generating an image~~

~~to be viewed by the user before and/or after vision correction~~

~~with the spectacles or the contact lenses.~~

~~The~~ spectacle and contact lens selecting method ~~set forth~~

~~in claim 24 of the present invention is recited in any one of~~

~~claims 13 to 23, wherein,~~ the step of generating and

displaying the wearing state ~~comprises:~~preferably includes the

step of acquiring an image of the user~~,~~ and the step of

synthesizing an image of spectacles or contact lenses to be

selected and the acquired image of the user.

The above and other elements, steps, characteristics,

features and advantages of the present invention will be

apparent from the following detailed description of preferred

embodiments of the present invention with reference to the

accompanying drawings.

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BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagram showing an example of a system configuration of a spectacle and contact lens selecting system ~~in an~~according to a preferred embodiment of the present invention;

Fig. 2 is a diagram showing ~~the schema of~~ a process when a user purchases spectacles or contact lenses;

Fig. 3 is a diagram showing ~~the schema of~~ a process of categorizing the user in the process of the spectacle and contact lens selecting system;

Fig. 4 is a diagram showing ~~the schema in the case~~a process where the user is a returning customer;

Fig. 5 is a diagram showing ~~the schema of~~ a process ~~in the case~~where the user is not a customer but has a prescription;

Fig. 6 is a diagram showing ~~the schema of~~ a process ~~in the case~~where the user is not a customer, does not have a prescription, and ~~is not destined~~does not intend to wear a pair of spectacles for presbyopia;

Fig. 7 is a diagram showing ~~the schema of~~ a process ~~in the case~~where the user is not a customer and does not have a prescription with no subjective symptom of presbyopia;

Fig. 8 is a diagram showing ~~the schema of~~ a process ~~in the case~~ where the user prefers a pair of ready-made

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spectacles for presbyopia;

Fig. 9 is a view showing a lens selection criterion database;

Fig. 10 is a view showing a lens database;

Fig. 11 is a schematic view of a screen at the top of a site;

Fig. 12 is a schematic view of a collecting screen of personal computer screen information;

Fig. 13 is a schematic view of a service selection screen;

Fig. 14 is a schematic view of a screen at the top of frame selection;

Fig. 15 is a schematic view of a PD measurement screen;

Fig. 16 is a schematic view of a facial image selection screen;

Fig. 17 is a schematic view of a self-portrait upload screen;

Fig. 18 is a schematic view of a virtual frame selection screen;

Fig. 19 is a schematic view of a different color display screen;

Fig. 20 is a schematic view of a saved-item confirmation screen;

Fig. 21 is a schematic view of a purchased frame confirmation screen;

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Fig. 22 is a schematic view of a lens power selection screen for having spectacles made;

Fig. 23 is a schematic view of a prescription data entry screen;

Fig. 24 is a schematic view of a lens thickness comparison screen;

Fig. 25 is a diagram showing an example of a configuration of a lens virtual try-on system equipped for the spectacle and contact lens selecting system ~~in an~~according to a preferred embodiment of the present invention;

Fig. 26 is a view showing an example of a database related to user information;

Fig. 27 is a view showing an example of data input by frame selection information input ~~means~~unit;

Fig. 28 is a view showing an example of a database structure related to a functional structure of a frame;

Fig. 29 is a view showing an example of a database structure related to a decorative structure of a frame;

Fig. 30 is a schematic view showing a measurement method on the lateral side of a facial image;

Fig. 31 is a schematic view showing a measurement method on the front side of the facial image;

Fig. 32 is a schematic view showing a frame adjusting method;

Fig. 33 is a view showing an example of a configuration

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of a remote subjective vision test system equipped for the
spectacle and contact lens selecting system in the <u>preferred</u>
embodiment of the present invention;

  Fig. 34 is a flowchart of screens for lens power decision
(No. 1);

  Fig. 35 is a flowchart of screens for lens power decision
(No. 2);

  Fig. 36 is a schematic view of a personal computer screen
information collecting screen;

  Fig. 37 is a schematic view of a user information entry
screen;

  Fig. 38 is a schematic view of a wearing condition entry
screen;

  Fig. 39 is a schematic view of a guidance screen
displayed at an astigmatism axis measurement step 1;

  Fig. 40 is a schematic view of an astigmatism axis
determination chart displayed at an astigmatism axis
measurement step 2;

  Fig. 41 is a view showing a state of the user at an
astigmatism axis measurement step 3;

  Fig. 42 is a view showing a state of the user at an
astigmatism axis measurement step 4;

  Fig. 43 is a schematic view of a far point distance
measurement target displayed at a far point distance
measurement step 1;

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Fig. 44 is a view showing a state of the user at a far point distance measurement step 2;

Fig. 45 is a view showing a state of the user at a far point distance measurement step 3;

Fig. 46 is a view showing a state of the user at a far point distance measurement step 4;

Fig. 47 is a view showing a state of the user at a far point distance measurement step 5;

Fig. 48 is a view showing an example how the far point distance measurement target is viewed at a far point distance measurement step 5-1;

Fig. 49 is a view showing a state of the user at a far point distance measurement step 7;

Fig. 50 is a preparatory state for executing a near point distance measurement;

Fig. 51 is a schematic view of a near point distance measurement target displayed at a near point distance measurement step 1;

Fig. 52(A) is a view showing a state of the user at a near point distance measurement step 2, and Fig. 52(B) is a view showing a state where a target is viewed with blur;

Fig. 53(A) is a view showing a state of the user at a near point distance measurement step 3, and Fig. 53(B) is a view showing a state where a target is viewed clearly;

Fig. 54 is a view showing a state of the user at a near

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point distance measurement step 4;

Fig. 55 is a view showing a state of the user at a near point distance measurement step 5;

Fig. 56 is a view showing a state of the user at a near point distance measurement step 6;

Fig. 57 is a view showing a state of the user at a near point distance measurement step 7;

Fig. 58 is a view showing a state of the user at a near point distance measurement step 8;

Fig. 59 is a schematic view of a near point distance measurement target displayed at a near point distance measurement step 9;

Fig. 60 is a view showing a state of the user at a near point distance measurement step 10;

Fig. 61 is a diagram showing an example of a configuration of an optometry system equipped for the spectacle and contact lens selecting system ~~in an~~according to a preferred embodiment of the present invention;

Fig. 62 is a view showing an example of a process flow of the optometry system;

Fig. 63 is a view showing an example of display of a personal information entry screen;

Fig. 64 is a view showing an example of display of a wearing condition entry screen;

Fig. 65 is a view showing an example of display of an

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explanatory screen for astigmatism axis determination;

Fig. 66 is a view showing an example of display of an astigmatism axis determination screen;

Fig. 67 is a view showing an example of display of an explanatory screen of a far point vision test;

Fig. 68 is a view showing an example of display of a far point vision test screen;

Fig. 69 is a view showing an example of display of an explanatory screen of near point distance measurement;

Fig. 70 is a view showing an example of a near point distance measurement screen;

Fig. 71 is a view showing an example of a configuration of a neural network for far point distance calculation;

Fig. 72 is a view showing an example of a configuration of a lens power decision system equipped for the spectacle and contact lens selecting system ~~in an~~according to a preferred embodiment of the present invention;

Fig. 73 includes schematic views, each showing a target for testing a far point vision where (a) shows the largest target, (b) shows a medium-sized target, and (c) is the smallest target;

Fig. 74 is a schematic view showing an eyeball optical model;

Fig. 75 is a flowchart showing an operation of a corrective lens deciding server according to a preferred

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embodiment of the present invention;

      Fig. 76 is a view showing a example of a relation between a sharpness score and a view; and

      Fig. 77 is a view showing a example of a screen for

5 confirming an image viewed before and after vision correction.

          DETAILED DESCRIPTION OF PRFERRED EMBODIMENTS

      Fig. 1 is a view showing an example of a system configuration of a spectacle and contact lens selecting system

10 ~~in an~~according to a preferred embodiment of the present invention. In ~~the drawing~~Fig. 1, the reference numeral 1 denotes a user client, the reference numeral 2 denotes a spectacle order/sales service center, and the reference numeral 3 denotes an external payment transaction agency. They

15 are physically connected to each other via a network. In the following description, ~~it is assumed that~~the network connecting the user client 1, the spectacle order/sales service center 2, and the external payment transaction agency 3 is preferably the Internet.

20   The user client 1 is a terminal used when a purchaser of spectacles makes an order for sales through the network~~,~~, for example, a personal computer having a network connection~~ function is used for it~~. The user client 1 is an input/output device serving as an interface with the user who uses it.

25 Although a general keyboard or mouse is used as the input

device for inputting information, a dedicated input device

such as a pointing device, such as a track ball or a joystick,

a touch panel, and a switch may be provided. As an image

display device, a general CRT display or a liquid crystal

5   monitor is preferably used. Furthermore, this user client 2001

includes an image input device for acquiring prescription data

as image information. Although a digital camera 11a and a

scanner 11b are preferably used as the image input device, any

devices capable of digitizing and inputting image information,

10   such as a video camera or a television camera may be used. The

user client 1 also includes a WWW browser 12 as an interface

for ~~making an~~ providing access to the spectacle order/sales

service center 2 ~~to get a service therefrom~~.

        The spectacle order/sales service center 2 is a server

15   for providing the user client 1 who is connected through the

Internet with a service to sell spectacles fitted to ~~a~~their

vision or in accordance with requests of each user ~~on~~to

order~~; it is composed of~~. The spectacle order/sales service

center 2 includes information processing equipment, such as a

20   personal computer or a work station having a network

connection function, and is connected to the user client 1

through the Internet. The spectacle order/sales service center

2 includes~~:~~ an electronic shop information processing

~~means~~unit 21~~,~~, a display information generating ~~means~~unit

25   22~~,~~, a spectacle order/sales processing ~~means~~unit 23~~,~~, a

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payment transaction ~~means~~unit 24~~,~~, a WWW server/CGI 25~~,~~, a

lens selecting ~~means~~unit 26~~,~~, a frame selecting ~~means~~unit 27~~,~~,

and a lens power deciding ~~means~~unit 28.

    The electronic shop information processing ~~means~~unit 21

5 defines item data, such as spectacle lenses and frames sold by

the spectacle order/sales service center 2 using an item

defining section 211 through the input/output device. The item

data defined herein is stored in an item database as item data

information.

10   In this preferred embodiment, the item data information

~~contains:~~includes text data, such as a name of a shelf on

which items such as frames are displayed, an item number of a

spectacle lens or frame ~~or the like~~, an item name, a price,

the description of an item, and item management information~~,~~.

15 image data of an item, such as a frame and ~~the like.~~other

useful information. The spectacle order/sales service center 2

also includes an input/output device serving as an interface

with a creator of an electronic catalog. The input/output

device receives the input of the item information, such as

20 text data such as a shelf name, an item category and a price

that are necessary for defining an item or image data

indicating a shape of an item from the catalog creator.

Moreover, this input/output device outputs information

~~containing~~including item information, such as an item number

25 and the number of items, delivery destination information of

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an item, payment information such an external payment

transaction agency name, a payment date, and the sum as order

information of an item purchased by the user.

An electronic shop opening information database

5   ~~containing~~including a shop database, an item database, and a

basket database is provided for the electronic shop

information processing ~~means~~unit 21. The shop database stores

information for opening an electronic shop and information for

defining a shop layout to display the item information. The

10   item database stores the defined item data information. The

basket database is for accumulating information of an item

~~directed~~selected by the user client 1 to be purchased. The

electronic shop information processing ~~means~~unit 21

~~realizes~~performs a function of storing the transferred item

15   data information in the item database.

The display information generating ~~means~~unit 22 generates

display information, such as the electronic catalog in

response to a request from the user client 1. The display

information generating ~~means~~unit 22 ~~is composed so as to~~

20   ~~include~~includes a parameter analyzing ~~means~~unit 221, a file

search ~~means~~unit 222, and a display data generating ~~means~~unit

223. The parameter analyzing ~~means~~unit 221 analyzes vision

test data and frame selection information ~~and the like~~

received from the user client 1 through the WWW server/CGI 25

25   so as to extract a parameter ~~contained~~included in the vision

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test data and frame selection information ~~and the like~~. The

file search ~~means~~unit 222 ~~makes a search in~~searches each

database registered and stored by the electronic shop

information processing ~~means~~unit 21 based on the parameter

5   extracted by the parameter analyzing ~~means~~unit 221. The

display data generating ~~means~~unit 223 generates display data

that ~~can be~~is displayed as a WWW page based on the data

searched by the file search ~~means~~unit 222. More specifically,

the display data generating ~~means~~unit 223 ~~has a~~

10   ~~function~~functions as a ~~so-called~~ WWW page generator.

The spectacle order/sales processing ~~means~~unit 23

receives a customer ID and an ID of an item to be purchased

from the display information generating ~~means~~unit 22 when the

item to be purchased (a spectacle lens, a frame or the like)

15   is ~~decided~~selected by the user client 1 so as to acquire

detailed information of the item to be purchased from the item

database based on ~~these~~this information. Then, it stores

information of the item in a customer basket database for a

target customer in the basket database. Thereafter, a list of

20   items to be purchased by the target customer is acquired from

the basket database so as to be ~~passed~~transmitted to the

display information generating ~~means~~unit 22.

The payment transaction ~~means~~unit 24 receives the

customer ID from the display information generating ~~means~~unit

25   22 when the item is ~~decided~~selected to be purchased by the

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user client 1 so as to ~~fetch~~retrieve item data information

corresponding to the user from the basket database. Then, it

requests the external payment transaction agency 3 to transact

the payment based on the ~~fetched~~retrieved item data

5   information. The payment transaction ~~means~~unit 24 is notified

of completion of the payment transaction by the external

payment transaction agency 3 so as to inform the spectacle

order/sales processing ~~means~~unit 23 and the electronic shop

information processing ~~means~~unit 21 of completion of the order

10   process. At the same time, it creates itemization data for

informing the user client 1 of a purchasing process so as to

deliver the data to the display information generating

~~means~~unit 22.

The WWW server/CGI 25 acts as an interface with the user

15   client 1 so as to receive display request information from the

user client 1 and to transfer display data to the user client

1.

The frame selecting ~~means~~unit 27 selects a frame

~~desired~~selected by the user from the frames displayed in a

20   virtual store. In this case, a frame selecting process

described in a spectacle virtual try-on system described below

is executed ~~so~~such that the user can select a frame while

watching an image of the user wearing a potentially purchased

frame.

25   The lens power deciding ~~means~~unit 28 remotely tests ~~a~~the

25

vision of the user to ~~decide a pwoer~~ determine the power of a
corrective lens. In this case, a vision test using an eyeball
optical model ~~described~~ for a remote subjective vision test
system described below is executed so as to ~~decide a~~

5 accurately determine the power of a corrective lens ~~with good~~
~~accuracy~~.

The lens selecting ~~means~~ unit 26 selects a lens fitted to
the user in consideration of the results of the vision test, a
budget, and the functions of a lens ~~, and the like~~.

10 The external payment transaction agency 3 provides a
payment service for the ordered spectacles ~~in place of~~ for the
spectacle order/sales service center 2 based on a request sent
from the payment transaction ~~means~~ unit 24 of the spectacle
order/sales service center 2.

15 Next, the schematic operations of the user client 1 and
the spectacle order/sales service center 2 will be described.

In the spectacle order/sales service center 2, the WWW
server/CGI 25 receives spectacle order page information sent
from the user client 1 so as to activate the display

20 information generating ~~means~~ unit 22.

Upon activation, the display information generating
~~means~~ unit 22 receives the spectacle order page information
from the WWW server/CGI 25 ~~so~~ such that the parameter
analyzing ~~means~~ unit 221 analyzes the received spectacle order

25 page information. The parameter analyzing ~~means~~ unit 221

26

outputs information, such as a shop ID for specifying an
electronic shop to be displayed, a catalog template for
specifying the type of a background screen of an electronic
catalog, an item ID of an item to be displayed, and a customer

5   ID for identifying a user~~, and the like~~ as the results of
analysis. Based on these data output from the parameter
analyzing ~~means~~unit 221, the file search ~~means~~unit 222 ~~makes a~~
~~search~~searches in the shop database, the item database, and
the basket database so as to acquire data ~~needed~~required to

10 create a display screen requested by the user client 1.

After ~~the~~acquisition of the data by the file search
~~means~~unit 222, the process proceeds to the display data
generating ~~means~~unit 223. The display data generating
~~means~~unit 223 first determines the type of the request from

15 the user client 1. If the request from the user client 1 is
other than "~~decision~~selection of an item to be purchased" or
"purchase of an item," the display data generating ~~means~~unit
223 uses the results of a search to create data for display by
the file search ~~means~~unit 223.

20   As a result of determination at the step of determining
the type of the request from the user client 1, if the type of
the request from the user client 1 is "determination of an
item to be purchased," that is, if the customer
~~directs~~instructs to "add a selected item into the shopping

25 basket" so as to indicate that the displayed item will be

27

purchased, the display data generating ~~means~~unit 223 activates

the spectacle order/sales processing ~~means~~unit 23.

Upon activation, the spectacle order/sales processing

~~means~~unit 23 receives the customer ID and the item ID of the

5   item ~~directed~~ selected to be purchased by the customer from

the display data generating ~~means~~unit 223. Then, it acquires

detailed item data information for the corresponding item from

the item database using the item ID as key information. Then,

the item data information acquired at the above-described step

10   is stored in the customer basket database of the customer

identified by the customer ID received from the display data

generating ~~means~~unit 223 in the basket database. At this time,

if the corresponding customer basket database does not exist,

a customer basket database corresponding to the customer ID is

15   created so as to store the item data information therein.

Furthermore, it ~~fetches out~~retrieves all ~~of~~ the item data

information selected by the user ~~by then~~ from the customer

basket database so as to deliver it to the display data

generating ~~means~~unit 223. In this case, the display data

20   generating ~~means~~unit 223 creates a list ~~of~~ display information

of items to be purchased by the customer from the item data

information received from the spectacle order/sales processing

~~means~~unit 23 so as to send it to the user client 1. ~~The~~At

this time, the customer can confirm the items to be purchased

25   or cancel a part ~~of~~or all of the items to be purchased based

28

on the information displayed ~~at this time~~.

  As a result of the determination at the step of

determining the type of the request from the user client 1, if

the type of the request from the user client 1 is "purchase of

an item," that is, if the customer ~~directs~~ makes the decision

~~of~~ to purchase ~~of~~ the items selected ~~by then~~, the display data

generating ~~means~~ unit 223 activates the payment transaction

~~means~~ unit 24 prior to creation of display data.

  Upon activation, the payment transaction ~~means~~ unit 24

receives the customer ID from the display data generating

~~means~~ unit 223. The payment transaction ~~means~~ unit 24 searches

the item data information of the items to be purchased, which

is stored in the customer basket database of the customer

identified by the customer ID from the basket database. Based

on the item data information obtained as a result of the

search, the external payment transaction agency 3 is requested

to make a payment transaction. In response to this request,

the external payment transaction agency 3 provides a payment

transaction service in place of the spectacle order/sales

service center 2 and then notifies the spectacle order/sales

service center 2 of completion of the payment transaction at

its completion. Since the payment transaction carried out by

the external payment transaction agency 3 is not

~~particularly~~ substantially different from a conventional one,

the detailed description thereof is ~~herein~~ omitted herein.

<div align="center">29</div>

When the payment transaction ~~means~~unit 24 is notified of
the completion of the payment transaction from the external
payment transaction agency 3, it transfers order information
including information related to the ordered item, such as an
5   item number and the number of ordered items, delivery
destination information indicating destination of the item,
and payment information ~~consisting of~~including a name of the
external payment transaction agency 3 executing the payment
transaction, a payment date, and sum information ~~and the like~~
10   to the spectacle order/sales service center 2. In the
spectacle sales service center 2, the order information
received from the WWW server/CGI is displayed by the
input/output device. Finally, the payment transaction
~~means~~unit 24 creates itemization data for notification of the
15   completion of the payment transaction and ~~passes~~transmits it
to the display data generating ~~means~~unit 223. The display data
generating ~~means~~unit 223 uses the received itemization data to
create a display screen for notification of the completion of
the payment transaction and ~~then to~~transfer it to the user
20   client 1.

Next, a method of ordering and selling spectacles by the
spectacle and contact lens selecting system will be described
below.

Fig. 2 is a view showing ~~the schema of~~a process ~~when~~in
25   which the user purchases spectacles or contact lenses. As

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illustrated, if the user wants to select a frame, a frame is
selected~~,~~; if the user wants to test his/her vision, an
uncorrected vision and a corrected vision are tested. If the
user wants to select a lens, a lens is selected. In response
to notification of payment in advance or part payment from the
payment transaction, spectacles or contact lenses are
processed or assembled based on the information of the
selected frame and the selected lenses and the result of the
vision test. Then, the item is delivered to the user cash on
delivery. Although the process is herein described as
proceeding in the order of the selection of a frame, the
vision test, and the selection of a lens, it is sufficient to
carry out only the processes ~~needed~~required by ~~a~~ the request
of the user and the order thereof may be arbitrary. For
example, ~~a~~ vision may be ~~first~~ tested first. Then, a lens may
be selected, and a frame may be selected at the final step. If
the user only wants to change a lens power, only a vision test
may be ~~carried out so~~ performed such that a lens or a frame
can be selected based on the customer database. If the user
only wants to replace a frame, only a frame may be selected
~~so~~such that ~~a~~ vision may be determined or a lens may be
selected based on the customer database.

Figs. 3 to 8 show ~~the schema of the~~ a process of the
spectacle and contact lens selecting system. Fig. 3 is a view
showing ~~the schema of~~ a process for first categorizing the

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user~~,~~. Fig. 4 is a view showing ~~the schema of~~ a process ~~in the~~ ~~case~~ where the user is a returning customer~~,~~. Fig. 5 is a view showing ~~the schema of~~ a process ~~in the case~~ where the user is not a customer but has a prescription~~,~~. Fig. 6 is a view

5   showing ~~the schema in the case~~ a process where the user is not a customer, does not have a prescription, and ~~is not~~ ~~destined~~does not intend to wear a pair of spectacles for presbyopia~~,~~. Fig. 7 is a view showing ~~the schema in the case~~ a process where the user is not a customer and does not have a

10   prescription with no subjective symptom of presbyopia~~, and~~. Fig. 8 is a view showing ~~the schema in the case~~a process where the user prefers a pair of ready-made spectacles for presbyopia.

First, when the spectacle order/sales service center 2

15   accepts the connection from the user client 1, it transmits a basic attribute entry screen for prompting input of basic attributes, such as a name, the date of birth and a telephone number. The user client 1 receives and displays the basic attribute entry screen so as to transmit the basic attributes

20   input by the user to the spectacle order/sales service center 2. The spectacle order/sales service center 2 receives the input basic attributes so as to search the customer database by the spectacle order/sales processing ~~means~~unit 23.

If, as a result of the search, it is determined that the

25   user is a customer who has already purchased spectacles ~~as a~~

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~~result of the search~~, the process proceeds to Fig. 4 where an inquiry screen for confirming the ~~intension~~ desires of the user is transmitted to the user client 1. If the user selects "I select the same lenses as the previous ones and the same

5   frame as the previous one" on the inquiry screen, lenses are created based on the vision test data, the frame information data, and the lens information data managed by the customer database (basket database). If the user ~~desires~~ wants to get new lenses and/or a new frame on the inquiry screen, a step

10   selecting screen for transition to a "lens power deciding step," a "frame selecting step," and a "lens selecting step" is transmitted to the user client 1. If the user selects "I don't want the same lens power as the previous one" on the selection screen, the "lens power decision step" is ~~carried~~

15   ~~out.~~performed. If "I select new frames," the "frame selecting step" is ~~carried out.~~performed. If "I select new lenses," the "lens selecting step" is ~~carried out.~~performed. At the "lens power deciding step" in this case, a "remote vision test system" described below is ~~carried out.~~performed. At the

20   "frame selecting step", an inquiry screen for making an inquiry whether a spectacle wearing virtual try-on is ~~carried~~ ~~out~~performed or not is transmitted to the user client 1. If the user selects "I try the spectacles on," the "spectacle virtual try-on system" is ~~carried out~~performed.

25   If he/she is not a customer, a prescription confirmation

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screen for ~~making an inquiry~~inquiring whether he/she has a
prescription from an ophthalmologist or not is transmitted to
the user client 1. If the user selects "I have a prescription
from a doctor" on the prescription confirmation screen, the
5   process proceeds to Fig. 5 where a prescription entry guidance
screen is transmitted to the user client 1. The user inputs
the prescription as image data from a scanner in accordance
with the guidance of the screen or as text data from the
keyboard so as to transmit it to the spectacle order/sales
10   service center 2. Then, as in the above-described case, the
step selecting screen for the transition to the "lens power
deciding step," the "frame selecting step," and the "lens
selecting step" is transmitted to the user client 1 so as to
execute each of the processes in response to the request of
15   the user.

   If the user selects "I don't have a prescription," an
inquiry screen for making an inquiry whether the age of the
user exceeds 40 through 45 years old or not is transmitted to
the user client 1. If the user selects "I am 40 through 45
20   years old or below" on the inquiry screen, the process
proceeds to Fig. 6 where the step selecting screen for
transition to the "lens power deciding step," the "frame
selecting step," and the "lens selecting step" is transmitted
to the user client 1 so as to execute each of the processes in
25   response to the request of the user.

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If the user selects "I am older than 40 through 45 years old," an inquiry screen whether he/she has the subjective symptom that he/she cannot clearly see in the vicinity of his/her hands or not is also transmitted to the user client 1.

5   If the user selects "I don't have any subjective symptoms" on the inquiry screen, the process proceeds to Fig. 7 where the step selecting screen for transition to the "lens power deciding step," the "frame selecting step," and the "lens selecting step" is transmitted to the user client 1 so as to

10 execute each of the processes in response to the request of the user. In this case, since there is a possibility that he/she ~~may be presbyope~~ has presbyopia in view of the age of the user, a "step of selecting the type from ~~longsightedness~~farsightedness, shortsightedness and bifocals"

15 is executed.

If the user selects "I have a subjective symptom," the spectacle order-sales service center 2 determines that the user ~~is presbyope~~has presbyopia and transmits an inquiry screen for ~~asking~~inquiring if he/she prefers custom-made

20 spectacles for presbyopia or not to the user client 1. If the user selects "I prefer custom-made spectacles" on the inquiry screen, the process proceeds to Fig. 7 where the step selecting screen for transition to the "lens power selecting step," the "frame selecting step," and the "lens selecting

25 step" is transmitted to the user client 1 to execute each of

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the processes in accordance with the request of the user. In
this case, the "step of selecting from spectacles for
~~longsightedness~~farsightedness, shortsightedness, and bifocals"
is further executed.

5   If the user selects "I prefer ready-made spectacles for
presbyopia," the process proceeds to Fig. 8 so as to decide a
lens power determined from the age of the user and then to
transmit the step selecting screen for transition to the
"frame selecting step" and the "lens selecting step" to the

10   user client to execute each of the processes in response to
the request of the user.

      Although it is described in the above process that the
basic information of the user is first input, a user ID and a
password may be issued to the user who has registered the

15   basic information in advance so as to enter the user ID and
the password when the user connects from the user client 1 to
the spectacle order/sales service center 2 for authentication.
In this case, it can be determined based on the user ID
whether the user is a customer who has already purchased

20   spectacles or not.

      Next, a ~~way~~method of providing a service will be
specifically described by using an example of a screen
displayed on the user client 1.

      First, the spectacle order/sales service center 2 first

25   transmits a screen at the top of a site (Fig. 11) to the user

                                36

client 1 and subsequently transmits a personal computer screen
information collecting screen (Fig. 12) to the user client 1
so as to instruct the purchaser to enter display (monitor)
information, such as a~the resolution and size of the personal
5   computer screen, thereby acquiring the display information
input by the user client 1.

     Next, on a service selecting screen (Fig. 13) transmitted
from the spectacle order/sales service center 2, the user
clicks any one of the "remote subjective vision test step
10   (World first! Self-check spectacle lens power identification
system)," the "frame selecting system (Try various spectacles
on! Frame fitting room)," the "lens selecting step (Use lenses
without vision correction)," and the "prescription supply step
(Use prescription data from an ophthalmologist or data of a
15   spectacle store card)" so as to transmit the ~~intension~~intent
of the user from the user client to the spectacle order/sales
service center 2.

     When lens selection criteria ~~of lenses become clear~~is
determined at the remote subjective vision test step or the
20   prescription supply step, the process proceeds to the lens
selecting step.

     Next, the lens selecting step will be described.

     When the user decides to use the most recent vision data
and therefore clicks "Select the same lenses as the previous
25   ones," when the user decides to have spectacles made based on

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prescription data from a doctor and therefore clicks "Select lenses in accordance with the prescription," or when the user determines to purchase ready-made spectacles for presbyopia and therefore clicks "Select ready-made spectacles for

5   presbyopia," the lens selecting ~~means~~unit 26 selects lenses based on the respective data.

If the user wants to remotely test his/her vision even though he/she has the most recent vision data or a prescription from a doctor, the user proceeds to the remote

10 vision test step by the vision deciding ~~means~~unit 28 so as to test his/her vision.

Although various lenses are registered as a database (Figs. 9 and 10) in the spectacle order/sales service center 2, the lens selecting ~~means~~unit 26 transmits a lens selection

15 screen, on which a lens satisfying the request of the user input from the user client 1 or a lens recommended by the spectacle order/sales service center 2 to the user is displayed from them, to the user client 1 based on the most recent vision data, the prescription from a doctor, or data

20 obtained by testing with the remote vision test system. Moreover, if the user is a returning customer, the previously purchased lenses are also displayed on the lens selection screen.

As choices in the selection of lenses, a manufacturer

25 name, a model, a purpose of use, lens functions (a lens

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thickness, a lens weight, endurance, UV protection), a color,

a price, and a lens power ~~and the like.~~are provided. The user

specifies these options to search a lens, selects a lens that

he/she wants to purchase, and transmits it to the spectacle

5   order sale service center 2.

        Next, the frame selecting step will be described.

        For example, if data regarding ~~frame~~functional and

decorative ~~aspects~~aspect of the frames is ~~present~~provided in

the spectacle order/sales service center 2 as in the case

10   where he/she is a returning customer, a frame can be specified

in view of fashion, image, design and the like.

        The frame selection in the case where the frame data in

terms of functions and decoration is present in the spectacle

order/sales service center 2 will be described below.

15   Frames are registered as a database in the spectacle

order/sales service center 2~~as a database~~. The frame

selecting ~~means~~unit 27 transmits a frame selection top screen

(Fig. 14), on which typical frames ~~among them~~are displayed,

to the user client 1. Then, the user answers questions in the

20   form of a questionnaire about fashion, ~~a~~material, design, ~~a~~

and budget~~, and the like so~~ such that the frame selecting

~~means~~unit 27 selects a frame which seems to be the most

suitable based on the data indicating the ~~intensions~~desires of

the user and transmits a frame selection screen to the user

25   client 1.

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The frame selection screen categorizes the spectacle
frames in accordance with gender/material and displays typical
frame images falling within the category.

If he/she is a returning customer, the previously
5   purchased frame is also displayed on the frame selection
screen.

~~As choices~~Choices of ~~a~~ frame~~, there are~~ include fashion,
~~a~~ material, design, ~~a~~ price, and ~~the like.~~other choices. The
user reads the options to enter the desired conditions,
10 selects a frame that he/she wishes to purchase from the
displayed frame images, and transmits it to the spectacle
order/sales service center 2.

At this time, this system is equipped with wearing state
display ~~means of~~ unit to virtually ~~putting~~ display the
15 selected frame on a model's face or his/her own face.

Next, ~~an~~a preferred embodiment of the wearing state
display ~~means constituting~~ unit according to the present
invention will be described using a spectacle virtual try-on
system shown in Fig. 25.
20   The spectacle virtual try-on system ~~realizes~~provides a
virtual experience ~~that~~ in which the user can put various
spectacle frames ~~can be put~~ on a face of a model or the user,
and is ~~constituted~~controlled by a user client 2001 and a
spectacle order/sales service center 2002. The user client
25 2001 and the spectacle order/sales service center 2002 are

40

physically connected through a network. In this case, the
following description will be given ~~assuming that~~ in which the
network _is the Internet.

The user client 2001 is a terminal used when the user
virtually tries spectacles on, and ~~is composed of~~includes, for
example, a personal computer having a network connection
function. Although a general CRT display or liquid crystal
monitor is preferably used as an image display device for
displaying a spectacle wearing state, a dedicated image
display device such as a head mount display (HMD) or a
projection-type display device may be ~~prepared.~~used. Moreover,
although a general keyboard or mouse is preferably used as an
input device for inputting information such as frame selection
information, a dedicated input device such as a pointing
device such as a track ball and a joystick, a touch panel, and
a switch may be prepared. Furthermore, this user client 2001
includes an image input ~~means~~unit for acquiring a facial image
of the user. Although a digital camera is preferably used in
this case, any devices capable of digitizing and inputting an
image such as a video camera and a scanner may be used.
Furthermore, the user client 2001 includes a WWW browser as an
interface for ~~making an access to~~accessing the spectacle
order/sales service center 2002 so as to receive a service
therefrom.

The spectacle order/sales service center 2002 is a server

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for providing a spectacle virtual try-on service~~, it is composed of~~. It includes information processing equipment such as a personal computer and a work station which has a network connection function, and is connected to the user

5 client 2001 through the Internet. The spectacle order/sales service center 2002 includes a WWW server ~~serving~~ as a contact point for providing a service to the user client 2001. Moreover, ~~it~~the spectacle order/sales service center 2002 includes~~:~~ a user information registering ~~means~~unit 2003 for

10 registering user information including a facial image of the user~~;~~, a frame selection information input ~~means~~unit 2004 for inputting selection information at the selection of a frame by the user~~;~~, a database management ~~means~~unit 2005 for conducting access management ~~to~~of the database~~;~~, a frame

15 information registering ~~means~~unit 2060 for registering the functional structures and the decorative structures of frames to be sold~~;~~, a frame image registering ~~means~~unit 2061 for registering the images of frames to be sold~~;~~, an image synthesizing ~~means~~unit 2007 for synthesizing a frame image and

20 a facial image of a model or the user~~;~~, and a frame selecting ~~means~~unit 2008 for selecting a corresponding frame based on the frame selection information. ~~It~~The spectacle order/sales service center 2002 is connected to the WWW server through an input ~~means~~unit 2006 and an output ~~means~~unit 2009. Each of the

25 ~~means~~units is activated by a CGI of the WWW server as ~~needed~~

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required so as to provide a spectacle virtual try-on service to the user client 2001. Moreover, the WWW server has a user authentication function for authenticating that the user client 2001 is a legitimate user.

5   The database managed by the database management ~~means~~unit 2005 includes a user information database, a frame selection information database, a frame functional structure database, and a frame decorative structure database as shown in Figs. 26 to 29.

10   Next, a process ~~procedure~~ for providing a spectacle virtual try-one service by this system to the user will be described.

First, a service provider activates the frame information registering ~~means~~unit 2060 to input functional structure data 15 and decorative structure data of spectacles to be sold by the keyboard ~~and the like~~or other suitable input device so as to register them on the databases.

As shown in Fig. 28 the frame functional structure data of each frame includes a size or an actual size (440 - 620), 20 and features such as a shape-memory alloy, super-light weight, super-elasticity, simultaneous function as sunglasses, portability and so forth. Also included are functions such as the distance between the right and left pupils, the widths from the center of the right and left pupils to the feet of 25 the ears, the opening angles of temples determined based on

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the widths from the center of the right and left pupils to the
feet of the ears, the distances from the feet of the ears to
the tops of the corneas, the bending positions of the temples,
the distances between the tops of the corneas and the foot of
5   the nose, and the opening angles of pad bridges determined
based on the distances between the tops of the corneas and the
foot of the nose. As shown in Fig. 29, the frame ornamental
structure data includes ~~as~~ shapes, such as Wellington, Lloyd,
Oval, Square, Tonneau, Boston, Butterfly, and Auto (Drop).
10   Materials are rimless (two-point, three-point), metal + nylon
rimmed, celluloid + nylon rimmed, metal, celluloid, brow-line,
combination and so forth. Brands include various brands, and
colors include various colors.

    The frame image registering ~~means~~ unit 2061 is also
15   activated to input images of the frames of spectacles to be
sold from the scanner ~~or the like~~ so as to register them on
the database.

    Next, when the user ~~makes an access to~~ accesses the WWW
server by using the WWW browser of the user client 2001, the
20   WWW server transmits a user authentication screen. The user
authentication screen instructs ~~an~~ a user to input ~~of~~ user
authentication information, such as a user ID and a password.
If the user authentication has already been completed at the
previous step, it ~~is~~ need not ~~required to~~ be executed again and
25   therefore is skipped.

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The database management ~~means~~unit 2005 makes a search in
the user information database ~~by~~using the input user
authentication information so as to execute the authentication.

If a service is provided for the user for the first time,
the user information registering ~~means~~unit 2003 is activated
to transmit a basic attribute entry screen to the user client
2001. After the user enters the user's basic attributes, for
example, name, address, date of birth, telephone number, eye
function (he/she cannot see_clearly ~~see~~in the area around
his/her hands~~ or the like~~, etc.), requirements for spectacles
~~and the like~~ in accordance with the screen, a user ID and a
password are issued to the corresponding user ~~so~~ such that the
received basic attribute information of the user is registered
on the user information database.

At the completion of the user authentication, the frame
selection information input ~~means~~unit 2004 is activated ~~so~~such
that a frame selection information entry screen
~~serving~~instructing the user to input frame selection
information is transmitted to the user client 2001. The frame
selection information entry screen is for inputting criteria
(fashion, a budget, functions, fitness to the face~~ and the ~~
~~like)~~, etc.) for selection of a frame by the user. The user
inputs frame selection criteria such as fashion, a budget,
functions, and the fit~~ness~~ to the face on the frame selection
information entry screen.

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Next, a PD measurement screen (Fig. 15) is transmitted to the user client 2001 for measurement of the position of a pupil ~~so~~such that the pupil is positioned at the center of a lens.

5   When the entry of the frame selection criteria in the text data and the PD measurement are completed, a facial image selection screen (Fig. 16) ~~for asking~~which asks "On which face do you want to try frames?" is transmitted. If the user selects "Use a model face," the process proceeds to a next

10 virtual frame selection screen. If the user selects "Use my self-portrait," a self-portrait upload screen (Fig. 17) is transmitted.

On the self-portrait upload screen, a screen ~~for asking~~which asks "Where is your picture data?" is transmitted

15 ~~so~~such that the user selects either "Use digital camera picture data" or "Use picture data obtained by a scanner." The user ~~fetches~~retrieves front and lateral (both on the right and left sides) facial images into the user client 2001 by the image input device so as to transmit them to the spectacle

20 order/sales service center 2002.

The frame selection information input ~~means~~unit 2004 receives the text data of the frame selection information and the image data (the facial images of the user) transmitted from the user client 2001 so as to register necessary

25 information on the frame selection information database in the

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following manner.

(1) Based on the side images (Fig. 30) of the user, the distances (L_1) between the feet of the ears and the tops of the corneas of the user are measured separately for the left and right, and the resulting data is registered. Based on the aforementioned measurements, the positions at which the temples are bent are determined separately for the left and right, and then registered.

(2) Based on the side images of the user, the distances (L_2) between the tops of the corneas of the user eyes and the foot of the nose are measured, and an average value of the left and right distances is registered. The distance L_2 is usually <u>about</u> 12mm. Based on the above measurements, the opening angles of the pad bridges are determined and registered.

(3) Based on the front image (Fig. 31) of the user, the widths (L_3) from the center of the pupils of the right and left eyes to the feet of the ears are measured separately for the left and right, and are then registered. Based on the above measurements, the opening angles θ of the temples are determined separately for the left and right and are registered.

For the widths from the center of the pupils of the right and left eyes to the ears, the distance between the pupils (PD) is first determined. However, the pupils cannot be

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precisely detected on the user face image, and therefore the
distance between the pupils (PD) is approximated, for example,
from the distance (PD_1) between the left side of the left eye
and the left side of the right eye.

5   The pupils cannot be detected from the face image.
Therefore, to determine the distance (L_4) between the pupil of
the left eye and the left ear, the distance from the foot of
the left ear to the right side of the left eye (L_a) and the
distance from the foot of the left ear to the left side (L_b) of

10   the left eye are determined. Then, the distance (L_4) between
the pupil of the left eye and the left ear is determined by
calculating an average of them. The distance between the right
eye and the right ear ~~can~~is also ~~be~~ determined in the same
manner.

15   The opening angles θ of the left and right temples of
the spectacle frame are adjusted, for example, by correcting
and bending the temples by the amount of angle obtained from
the following equation.

        $PD/2 + L_4 - L_5$

20   where L_5 is the front size of the spectacle frame (Refer
to Fig. 32).

        (4) When bifocal lenses are specified, an additional
bending angle of 5 degrees is provided for the angle of
inclination of the lens surface. For this reason, the opening

25   angle of the pad bridges is determined and registered ~~by~~after

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being corrected with the additional angle of bending.

Thus, the frame selection information input ~~means~~unit 2004 ~~perform computation~~performs computations to create functional structure data, ornamental structure data, and face image data, which are in turn stored by the database management ~~means~~unit 2005 in conjunction with the face image data.

At the spectacle order/sales service center 2002, the frame information registering ~~means~~unit 2060 and the frame image registering ~~means~~unit 2061 store in advance the frame functional structure, the frame ornamental structure, and the frame image of each frame. An appropriate frame is selected corresponding to the functional structure data, ornamental structure data, and face image data according to the frame selection criteria transmitted from the user client 2001.

After the selection of several types of ~~frame~~frames conforming to the frame selection information by the frame selecting ~~means~~unit 2008, the virtual frame selection screen (Fig. 18) is transmitted to the user client 2001. On the virtual frame selection screen, "Try various frames and save the ones you like (up to four frames) for now" is displayed so as to instruct the user to select frames that interest him/her. As a result, the user can virtually try the selected frames on ~~so as to~~and save frames that interest him/her ~~for now~~in view of the results of virtual try-on.

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On the virtual frame selection screen, ~~there are~~ search criteria such as "material and price range," "material and brand," "material and price range and brand," ~~and the like as search criteria.~~etc. are displayed. As choices for material,

5 "Plastic," "Metal," "Two-point," "Nairoll," "Combination," "SG," and ~~the like~~other suitable choices are displayed ~~so~~such that a selection can be made ~~from them~~. As choices of price range, "5000 to 9999 yen," "10000 to 14999 yen," "15000 to 19999 yen," "20000 to 30000 yen," and ~~the like~~other suitable

10 ranges are pull-down displayed ~~so~~such that a selection can be made ~~from them~~. As choices of brand, various brand names are pull-down displayed ~~so~~such that a selection can be made ~~from them. The number~~. A maximum of four frames ~~which~~are ~~allowed~~permitted to be saved ~~is four at maximum~~. If the number

15 of frames exceeds ~~it~~four, the frames are appropriately reselected so as to ~~put~~delete the unnecessary ones ~~into a dust box to delete them~~.

An image of each of the selected frames is resized and synthesized so as to fit to the facial image of the user by

20 the image synthesizing ~~means~~unit 2007 to generate a spectacle wearing image. Then, the generated spectacle wearing image is transmitted to the user client 1 as ~~a~~part of the virtual frame selection screen (Fig. 18). At this time, lateral images of the frame may be simultaneously displayed. Furthermore, a

25 spectacle wearing image obtained by synthesizing the image and

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the lateral images of the user may be generated and displayed by the image synthesizing ~~means~~unit 2007. As a result, the user can confirm the fit~~ness~~ on the lateral faces of the frame.

If "See a different color" is selected on the virtual frame selection screen, a different color display screen (Fig. 19) is transmitted to the user client 2001. On the different color display screen, all different colors of the same model are displayed to show items in different colors. If the number of frames in different colors is less than 8, a field is displayed as a blank.

The user sees a spectacle wearing image displayed on the user client 2001 so as to confirm if the selected frame meets his/her requirements ~~and the face with the frame on~~.

If an image of a frame different from the desired one is transmitted or it is desired to see the face with another frame ~~in this case~~, the user specifies the frame selection information again so as to transmit it to the spectacle order/sales service center 2002. As a result, another frame is selected by the same method as ~~that~~ described above. A spectacle wearing image obtained by synthesizing an image of the frame selected by the user and the facial image is generated by the image synthesizing ~~means~~unit 2007 so as to be transmitted to the user client 2001 again.

Next, ~~in order that~~to enable the user ~~confirms~~to confirm the frames saved on the virtual frame selection screen (Fig.

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18) and the different color display screen (Fig. 19), a saved-item confirmation screen (Fig. 20) is transmitted to the user client 2001. On the saved-item confirmation screen, "Confirm the saved frames and select the one that I want to purchase"

5   is displayed. As a result, a frame can be selected simultaneously with a virtual experience.

If the user purchases the frame confirmed through the virtual experience with color lenses, a predetermined part is clicked.

10   Next, a purchased frame confirmation screen (Fig. 21) is transmitted to the user client 2001 so as to instruct the user to confirm the type of frame and the type of lenses to be purchased. On the purchased frame confirmation screen, an image with the selected frame on, the type of frame and the

15   type of color lenses are displayed. If he/she does not ~~need~~want to purchase an item, he/she clicks "Cancel." If he/she wants to purchases ~~them~~the item, he/she clicks "Buy."

If "Buy" is selected on the purchased frame confirmation screen, a lens power selection screen (Fig. 22) for having

20   spectacles made is transmitted to the user client 2001. On the lens power selection screen for ~~getting~~ spectacles, the question "Which lens power data do you use for the spectacles on this order?" is ~~given.~~displayed. As choices, "Use lens power data tested on this site," "Use lenses without vision

25   correction," and "Use prescription data from an

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ophthalmologist or data of a card from a spectacle store" are
displayed so as to instruct the user to make a selection from
the "lens power deciding step," the "lens selection step," and
the "prescription supply step."

5   If "Use prescription data from an ophthalmologist or data
of a card from a spectacle store" is selected, the process
proceeds to the "prescription supply step" so as to transmit a
prescription data entry screen (Fig. 23) to the user client
2001. On the prescription data entry screen, "Enter a lens

10   power" is displayed so as to instruct the following input.

· PD (in mm)

· Right eye S (pull-down display of lens power data: +0.25, -
0.25, -0.50, -0.75, -1.00 and the like), C, AX (pull-down
display of astigmatism axis data: 180° ± 22.5°, 135 ± 22.5°, 90

15   ± 22.5°, 45 ± 22.5°, 0 ± 22.5° and the like)

· Left eye S (pull-down display of lens power data: +0.25, -
0.25, -0.50, -0.75, -1.00 and the like), C, AX (pull-down
display of astigmatism axis data: 180° ± 22.5°, 135 ± 22.5°, 90
± 22.5°, 45 ± 22.5°, 0 ± 22.5° and the like)

20   If "Use lenses without vision correction" is selected on
the lens power selection screen for ~~getting~~ spectacles and if
the prescription data is input on the prescription data entry
screen, a lens thickness comparison screen (Fig. 24) is
transmitted to the user client 2001. On the lens thickness

25   comparison screen, "Which lenses do you want for the

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spectacles? Thickness is displayed in accordance with your
lens power" is displayed to ~~display~~show cross-sectional shapes
and lens prices for a "standard lens," a "thin lens," and a
"thin lens without distortion" ~~so~~such that the user can
5 compare the thicknesses of the lenses.

      When the frame is selected, the process proceeds to the
payment system.

      As described above, according to the spectacle virtual
try-on system, the user can put various spectacle frames on
10 the picture data. In addition, he/she can try various
spectacle frames on at home through a network, such as the
Internet, without going to a store so as to select the most
suitable frame meeting his/her own preferences. Moreover,
according to this system, since he/she can confirm~~s~~
15 himself/herself with the selecting spectacle frame on while
wearing his own spectacles or contact lenses, that is, with
proper vision, a spectacle frame optimal for him/her can be
selected.

      In the above-described preferred embodiment, the
20 spectacle virtual try-on system, which allows various
spectacle frames to be put on the picture data of the user as
the wearing state display ~~means~~unit, has been described.
However, not only a spectacle frame but also contact lenses
may be virtually tried on by using similar image synthesizing
25 ~~means.~~unit. In particular, with color contact lenses ~~and the~~

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like on, the image of the face greatly changes. Therefore, if
the image when wearing them can be confirmed, the user is
assured to select suitable contact lenses.

Next, a first preferred embodiment of lens power
5   determination step is explained below by using a remote
subjective vision measurement system as shown in Fig. 33. As
illustrated, the remote subjective vision measurement system
10 comprises includes hardware of user clients 4001 and a
spectacle order/sales service center 4002. These are
10 physically connected to each other via networks. The following
descriptions will be given assuming that the network
connecting between the user clients 4001 and the spectacle
order/sales service center 4002 is the Internet.

A user client 4001 is a terminal used when the user
15 receives a vision test service. Like the above-described user
client 1, a personal computer having an Internet connection
function and the like is used as the user client.

A spectacle order/sales service center 4002 is a server
for providing a vision test service and is composed of
20 includes information processing equipment, such as a personal
computer, or a work station, and the like having a network
connection function so as to be connected to the user client
4001 through the Internet.

The spectacle order/sales service center 4002 includes a
25 WWW server 4030 serving as a contact point for providing a

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service to the user. Moreover, ~~it~~the spectacle order/sales service center 4002 includes an eyeball optical model deciding ~~means~~unit 4204, a model validity examination ~~means~~unit 4206, an eyeball optical dimensions-accommodation range determination ~~means~~unit 4208, an eyeball optical model image generating ~~means~~unit 4210, an eyeball optical model focal performance examination ~~means~~unit 4212, a viewed image generating ~~means~~unit 4214, a sharpness score generating ~~means~~unit 4216, a lens power selecting ~~means~~unit 4218, a user information management ~~means~~unit 4230, and a database management ~~means~~unit 4232. ~~It~~The spectacle order/sales service center 4002 is connected to the WWW server 4030 through an input ~~means~~unit 4202 and an output ~~means~~unit 4220. Each of the ~~means~~units is activated by a CGI of the WWW server as ~~needed~~required so as to provide a vision test service to the user client 4001. Moreover, the WWW server has a user authentication function for authenticating that the user client 4001 is a legitimate user.

The input ~~means~~unit 4202 inputs information ~~of~~about the eyes of a subject, such as wearing conditions of the subject, age, a near point distance, ~~and~~a far point distance~~, and the like~~.

The eyeball optical model deciding ~~means~~unit 4204 is designed to determine a start eyeball optical model in accordance with the age of a subject and information

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onregarding the eyeeyes, such as the approximate lens power. The eyeball optical model deciding meansunit 4204 is designed to determine an eyeball optical model in accordance with such eyeball optical dimensions that the focal state of the eyeball

5   of a subject is optimized at the accommodation midpoint calculated from the near point distance and the far point distance of the subject.

The model validity examination meansunit 4206 further examines the validity of the eyeball optical model at the

10 accommodation limit on the near point side and/or the far point side.

The eyeball optical dimensions-accommodation range determination meansunit 4208 is constituteddesigned so as to determine the range of accommodation of an eyeball at an

15 accommodation midpoint, and in addition displays an image of an eyeball optical model, in which the range of accommodation of the eyeball at the accommodation midpoint is determined.

The eyeball optical model focal performance examination meansunit 4212 examines a focal state of the eyeball optical

20 model at a near point or a position within the range of accommodation ability in the vicinity of the near point, at a far point or a position within the range of accommodation ability in the vicinity of the far point, or a position away from the near point and the far point in a naked eye state of

25 the subject. Furthermore, the eyeball optical model focal

performance examination ~~means~~unit 4212 examines a focal state

of the eyeball optical model of the subject at a near point or

a position within the range of accommodation ability in the

vicinity of the near point, at a far point or a position

5   within the range of accommodation ability in the vicinity of

the far point, or a position away from the near point and the

far point after vision correction with spectacles or contact

.   lenses.

The viewed image generating ~~means~~unit 4214 generates

10 visual images viewed by the subject before and/or after the

correction by ~~means~~unit of a spectacle or contact lens.

The sharpness score generating ~~means~~unit 4216 derives the

sharpness score of the viewing by the subject before and/or

after the correction by ~~means~~unit of a spectacle or contact

15 lens.

The lens power selecting ~~means~~unit 4218 examines optical

performance when the subject wears spectacles or contact

lenses so as to select a lens power.

Next, a method of testing ~~a~~ vision by using this remote

20 subjective vision test system will be described in accordance

with a flow of Figs. 34 and 35.

After the user client 4001 ~~makes an access to~~accesses the

spectacle order/sales service center 4002 to complete the user

authentication, a guidance screen is transmitted to the user

25 client 4001 ~~so as to be~~and displayed.

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Next, a personal computer screen information collecting
screen (Fig. 36) is transmitted to the user client 4001. On
the personal computer screen information collecting screen,
"Give us your personal computer information; necessary to get
5   spectacles fitted to your eyes" is displayed so as to instruct
the ~~entry of~~ user to enter display information, such as ~~a~~the
screen resolution. Then, "How long is this line in centimeters
on your monitor screen?" so as to instruct the entry of size
of the display.

10   Next, a user information entry screen (Fig. 37) is
transmitted to the user client 4001. On the user information
entry screen, the user is instructed to enter user information
and data as information identifying the user. The user
information includes base attributes such as a user code, a
15   user identifier (ID), a user password, address, name, the date
of birth, and telephone number, and data include the purpose
of use, a near point distance, a far point distance, age, the
previous lens power, vision of both eyes at the previous lens
power, the balance of the right and left eyes at the previous
20   lens power, how many years the previous spectacles are used,
the type of contact lenses (if also used), desired corrected
vision, and a disease related to vision. After the entry of
the personal information, a wearing condition entry screen
(Fig. 38) is transmitted to the user client 4001. As wearing
25   conditions, the purpose of wearing spectacles or contact

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lenses (the situations in which he/she wants to wear them, for example, to see the area around his/her hands, to see objects in the distance and to drive a car and the like) or a visual environment (at which distance and in which area he/she often

5   see objects in daily life, if she/he has much work on a personal computer as business activity, and ~~the like~~other environmental information).

Next, an uncorrected vision test screen is transmitted to the user client 4001.

10   An uncorrected vision test is executed in the order of astigmatism axis measurement, a far point vision test, and a near point vision test. Although a measurement method of estimating a far point distance by the measurement at a certain distance (at a distance equal to a length of a human

15   arm) is used in this preferred embodiment, a method of directly measuring a far point distance may also be used.

The astigmatism axis measurement is performed in the following procedure.
An astigmatism axis measurement step 1: First, a guidance

20   screen is transmitted (Fig. 39) to display "Follow the following instructions. The right eye is measured. First, four zones hatched with parallel lines are displayed. Move about 1 m away from the screen and then come up to the position where you can clearly see the lines of any one of the

25   four zones. Remove the spectacles or the contact lenses at

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this step. When watching a displayed target, cover your left
eye with a hand so as not to touch the eye."

An astigmatism axis measurement step 2: Next, an astigmatism
axis measurement screen is transmitted so as to display an
5 astigmatism axis determination chart ~~composed of~~including four
patterns on the screen (Fig. 40).

An astigmatism axis measurement step 3: At this step, the user
moves away about 1 m while covering the left eye with the left
hand. At this time, the left eye is kept open. A state of the
10 user at this step is shown in Fig. 41.

An astigmatism axis measurement step 4: Next, the user brings
his/her face gradually closer to the screen and stops at a
distance allowing the distinction of four patterns. He/she
should be careful not to be too close. A state of the user at
15 this step is shown in Fig. 42.

An astigmatism axis measurement step 5: At this step, it is
determined whether the four patterns in the drawing appear the
same to the user or any one of them appears darker or brighter.

An astigmatism axis measurement step 5-1: If "One of them
20 appears dissimilar," the corresponding pattern is clicked.

An astigmatism axis measurement step 5-2: If "All zones viewed
equally well" or "Indistinguishable," the comment below the
patterns is clicked.

An astigmatism axis measurement step 6: Subsequently, the
25 right eye is covered with the right hand so as to execute the

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same process for the left eye.

An astigmatism axis determination chart ~~is composed of~~includes linear groups in four directions, at 45 degrees, 90 degrees, 135 degrees, and 180 degrees, each ~~being formed by~~having a plurality of parallel lines as shown in Fig. 40. If the subject is astigmatic, he/she has a clear view in a certain direction but the zone appears as if it were compressed and paled in another direction. Therefore, he/she is instructed to click the zone which appears dissimilar. The reason ~~why~~that the direction in which a view is different is selected is because the direction giving a clear view for an astigmatic may possibly be reversed at 90 degrees, depending on a distance to the object. Therefore, there is a possibility that the axis of astigmatism is erroneously determined if the direction giving a clear view is determined first. Accordingly, in preferred embodiments of the present invention, the principal axis of astigmatism is not determined yet at this step. At a later step of obtaining a far point distance, two far point distances calculated by targets in two directions are compared with each other ~~so~~such that the direction with a longer distance is determined as the principal axis.

Since the subject who is not astigmatic should principally ~~has~~have a uniform view in all the directions, the subject who clicks "All zones viewed equally well" or "Indistinguishable" is regarded as non-astigmatic so that the

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following measurement is performed only for horizontal and vertical principal axes.

In the case where a resolution of the determination of axis of astigmatism is desired to be enhanced, linear groups in four directions at intermediate angles between the respective four directions, that is, at 22.5 degrees, 67.5 degrees, 112.5 degrees, and 157.5 degrees may be added and displayed for selection.

Next, a far point distance is measured. Primarily, the far point distance measurement examines how ~~long~~far away from the screen the subject can ~~position away from a screen,~~ be located while watching the screen in a comfortable manner. He/she stops ~~the face~~ at the farthest ~~position~~location at which he/she can see without blur (the position at which the screen starts ~~being blurred)~~.to blur). A distance measured from the screen to the eye corresponds to a far point distance. However, since there is a limit in moving away from the personal computer, the far point distance is calculated by measuring a far point vision at a certain distance ~~in this case~~.

The far point vision is measured by determining the limit of size of an object that the user can see at a certain distance. The far point vision in this preferred embodiment does not mean a generally used power unit such as 1.5 but another numerical unit. Hereinafter, the far point vision will

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be described in detail. The subject ~~perfectly stretches out~~fully extends his/her arms while touching a display with fingers. He/she ~~perfectly stretches out~~extends the arms with ~~the ramrod~~a straight posture. In this state, targets for

5   measuring the far point vision are displayed on the display as shown in Fig. 43. The subject selects the smallest one of the displayed targets, of which three black ~~three~~lines he/she can clearly see. The number assigned to the target selected by the subject is determined as the far point vision. The far point

10   distance is calculated from the far point vision based on the size of the target and the distance from the screen.

The far point vision is measured in the following procedure.

A far point distance measurement step 1: A far point distance

15   measurement screen is transmitted ~~so that a screen~~on which far point distance measurement targets, each being different in size with three vertical lines, are displayed in a set ~~is displayed~~(Fig. 43).

A far point distance measurement step 2: At this step, the

20   user touches the edge of the personal computer screen with the middle finger while ~~perfectly stretching out~~fully extending the right arm to the fingertips. A state of the user at this step is shown in Fig. 44.

A far point distance measurement step 3: Next, the user covers

25   the left eye with the left hand so as to see the far point

distance measurement targets with the right eye. A state of
the user at this step is shown in Fig. 45.

A far point distance measurement step 4: Next, the user
~~sees~~views a far point distance measurement chart displayed on
the screen with ~~the ramrod~~a straight posture ~~in this state~~. A
state of the user at this step is shown in Fig. 46.

A far point distance measurement step 5: At this step, it is
determined whether the user can recognize three lines in the
image or not. A state of the user at this step is shown in Fig.
47.

A far point distance measurement step 5-1: If the user cannot
recognize three lines in any one of them, he/she clicks "YES."
If the user recognizes three lines (even in the case where
they are "blurred"), he/she clicks "NO." The criterion of
recognition of the three lines is, for example, ~~as~~ shown in
Fig. 48.

A far point distance measurement step 5-2: At this step, if
the user answers "NO," the far point measurement targets are
displayed in ~~the smaller~~order of size so as to repeat a check
until the image of which three lines are recognized appears.

A far point distance measurement step 6: Subsequently, the
chart on the screen is changed to display far point distance
measurement targets, each with three horizontal lines, so as
to ~~direct the~~perform a measurement (not shown).

A far point distance measurement step 7: Similarly, the user

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sees the far point distance measurement targets with the right
eye while covering the left eye with the left hand so as to
carry out the same check. A state of the user at this step is
shown in Fig. 49.

5   The check for the right eye is completed at this step.
A far point distance measurement step 8: Next, the left eye
will be checked. As for the right eye, the user touches the
edge of the personal computer screen with the middle finger
while ~~perfectly stretching out~~fully extending the left arm to
10   the fingertips. He/she covers the right eye with the right
hand to see the far point distance measurement targets with
the left eye so as to carry out a check for the left eye in
the same manner as for the right eye.

        Although the far point distance is measured with the
15   targets, each ~~with~~having three vertical lines, ~~and the targets,~~
~~each with three horizontal lines,~~ in the above description,
the measurement is performed in the direction selected by the
above-described astigmatism axis measurement and the direction
perpendicularly crossing it. If the user is oblique astigmatic,
20   the far point distance should be measured in two directions at
45 degrees and 135 degrees.

        Although the screen, on which the targets of all sizes
are combined, is first displayed ~~so~~such that the targets are
then displayed in ~~the smaller~~order of size in the above
25   description, the present invention is not limited thereto. The

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targets may be individually displayed from the beginning. On
the screen on which a plurality of targets are combined, the
smallest target whose three lines can be recognized may be
selected and clicked.

5   Next, a near point distance is measured. The near point
distance measurement examines how close the subject can get to
the screen while ~~watching~~viewing the screen in a comfortable
manner. He/she stops the face at the nearest position at which
he/she can see without blur. A distance measured between the
10 screen and the eyes corresponds to a near point distance.

The near point distance is measured in the following
procedure.

The user folds a sheet of newspaper or copy paper in an
elongated form (at a width of about 3 to 5 cm) and puts it
15 beside the personal computer (Fig. 50).

A near point distance measurement step 1: A near point
distance measurement screen is transmitted so as to display a
near point distance measurement target with three vertical
lines on the screen (Fig. 51).

20 A near point distance measurement step 2: At this step, the
user ~~brings~~moves his/her face as close to the screen as ~~much~~
~~as~~ possible while covering the left eye with the left hand
(Fig. 52(A)). At this time, he/she verifies that the target is
blurred. Fig. 52(B) shows a state where the near point
25 distance measurement target is viewed as blurred.

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A near point distance measurement step 3: Next, the user ~~positions~~moves his/her face away ~~to the position where~~from the screen until he/she can recognize the three lines displayed on the screen (Fig. 53(A)). He/she should be careful that they
5 may be recognized at the position extremely close to the screen in some cases. A state where the near point distance measurement target is clearly seen is shown in Fig. 53(B).

A near point distance measurement step 4: Next, he/she stops ~~the face~~ at the ~~position allowing the recognition.~~closest
10 location at which he/she can recognize the target. Then, he/she rests his/her elbows on the desk and puts the folded paper on the temple. He/she ~~picks~~marks the paper with the fingers ~~in~~at the eye corner area. A state of the user at this step is shown in Fig. 54.

15 A near point distance measurement step 5: Next, he/she puts the top of the folded paper perpendicularly to the screen without moving ~~the~~his/her face. A state of the user at this step is shown in Fig. 55.

A near point distance measurement step 6: Next, the paper is
20 marked with the index finger of the left hand for the position of the right eye corner. After marking, the face may be moved. A state at this step is shown in Fig. 56.

A near point distance measurement step 7: At this step, the user presses a button "measure" on the upper left of the
25 screen (Fig. 57).

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A near point distance measurement step 8: The end of the paper is aligned with the position 0 of the "measure" appearing on the screen so as to measure a distance to the mark (Fig. 58). Three "measures" are displayed on the screen. If one measure

5   is not sufficient, the paper is marked for the end of the measure and the remaining part is measured with the second one. If even two measures are not sufficient, the same operation is repeated for the third one.

A near point distance measurement step 9: Once "Next" button

10 is clicked, a near point distance measurement target with three horizontal lines is displayed on the screen (Fig. 59). A near point distance measurement step 10: The same check is carried out while the left eye is being covered with the left hand (Fig. 60).

15 A near point distance measurement step 11: When the length is measured, the check for the right eye is completed. Next, the left eye is checked in the same manner while the right eye is being covered with the right hand (not shown).

        For the above-described near point distance measurement

20 target, thin lines are used independently of vision of the subject.

        Although the near point distance is measured for the target with three vertical lines and the target with three horizontal lines in the above description, the measurement is

25 performed in the direction selected by the above-described

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astigmatism axis measurement and the direction perpendicularly crossing it. If the user is oblique astigmatic, the near point distance is measured in two directions at 45 degrees and 135 degrees.

5   The basic data measurement necessary for deciding a lens power is completed by the above operation. An eyeball optical model is constructed based on the basic data. In an eyeball optical model, an optical function of an eyeball within the range of accommodation of the user is detected so as to select

10   a lens power. The selection of a lens power based on the eyeball optical model will be described in detail in a lens power deciding system described below.

       A second preferred embodiment constituting of the lens power deciding step will be described by using an optometry

15   system as shown in Fig. 61. As illustrated, in this optometry system, a computer 6001 used by the subject and an optometry server 6010 providing an optometry method of the present invention are also connected to each other through the Internet 6002.

20   The optometry server 6010 is for providing an optometry service to the subject computer 1, and includes a WWW server 6020, a display screen database 6030, user interface meansunit 6040, a subject database 6050, far point distance calculation meansunit 6060, and lens power calculation meansunit 6070.

25   The WWW server 6020 accepts an access from the subject

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computer 6001 so as to provide an optometry function in
accordance with an optometry procedure of the present
invention. An HTTP server is used ~~so~~such that the subject
computer 6001 can be ~~served~~ accessed by a general-purpose Web
5   browser.

        The display screen database 6030 stores screen data that
the WWW server 6020 presents to the accessed subject computer
in accordance with the optometry procedure of the present
invention. In this case, the first guidance screen, a
10   subject's attribute entry screen, an astigmatism axis
determination screen, a far point vision test screen, and a
near point vision test screen~~, and the like~~ are stored in an
HTML format.

        The user interface ~~means~~unit 6040 stores the attributes
15   of the subject in the optometry information database 6050,
activates the far point distance calculation ~~means~~unit 6060 to
calculate a far point distance or activates the lens power
calculation ~~means~~unit 6070 to calculate a lens power based on
the information entered by the subject on the screen displayed
20   by the WWW server 6020 on the subject computer 6001.

        The user interface ~~means~~unit 6040 is ~~a process~~ activated
from the WWW server 6020 by a CGI, whereas the far point
distance calculation ~~means~~unit 6060 and the lens power
calculation ~~means~~unit 6070 are ~~processes~~ activated from the
25   user interface ~~means~~unit 6020. The optometry information

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database 6050 stores subject attribute data entered by the subject, selected direction data of the astigmatism axis determination chart(right and left eyes), visibility limit data based on the vision test chart (right and left eyes × two directions), near point distance data based on the near point distance measurement chart (right and left eyes × two directions), calculated far point distances (right and left eyes × two directions), and calculated lens powers (right and left eyes) ~~and the like~~.

Next, an example of a procedure of eye examination by such an optometry system will be described with reference to Fig. 62.

First, the procedure displays a subject attribute input screen for acquiring the attributes of a subject (S10), and then acquires the attributes entered by the subject ~~to store~~and stores them as the subject data (S12). The attributes of the subject include the personal information such as the age, the gender, and the height, and wearing condition information regarding the situation where the spectacles or the contact lenses are mainly used. Fig. 63 is an example of a display screen for acquiring personal information, and Fig. 64 is an example of a display screen for acquiring wearing conditions. Here, it is assumed that the "reading" in the wearing conditions is for near distances, the "—deskwork" and "personal computer" for intermediate distances, and the

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"driving cars" for far distances.

Then, the procedure displays an astigmatic axis measurement chart for determining the astigmatic axis (S14) to acquire the orientation that the subject has selected and

5   store it as selected orientation data (S16). Fig. 65 is an explanatory view illustrating an example of a screen for use with the astigmatic axis measurement, Fig. 66 showing an example of the astigmatic axis measurement screen.

As illustrated, the astigmatic axis measurement chart is

10   made up of four groups of a plurality of parallel lines, each group having lines extended in one orientation at an angle of 45 degrees, 90 degrees, 135 degrees, and 180 degrees, respectively. A subject with astigmatism ~~experiences~~views the orientation which provides ~~the~~ a_ sharper ~~viewing~~ view_ and the

15   orientations which provide ~~the~~ a_ less-sharper blurry view~~ing~~, and is instructed to click on the zone in the orientation that provides a different view~~ing~~. The procedure instructs the subject to select the orientation that provides a different view~~ing~~ as mentioned above. This is because astigmatism may

20   possibly cause a 90 degree-inverted orientation to provide the sharper view~~ing~~ depending on the distance to the object, and thus ~~employing~~using the orientation that provides the sharper viewing at the first ~~gaze~~viewing would possibly cause an error in measurement of the astigmatic axis. Therefore, the present

25   invention is designed not to determine the main axis of the

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astigmatic axis at this stage but to determine the orientation
that is longer in distance as the main axis by comparing the
two far point distances calculated using the targets in two
orientations at the later stage where a far point distance is
5   calculated.

     In principle, a subject without astigmatism is probably
provided with the same view~~ing~~ in all the orientations. Thus,
the subject who clicks on "All are viewed in the same way" or
"Indistinguishable" is considered to have no astigmatism and
10   undergoes the following measurements only on the horizontal
and vertical main axes.

     The astigmatic axis measurement chart has ~~the~~a green
background ~~in green~~ and ~~the~~black lines ~~in black~~, with the
width of the lines ~~having~~being two pixels and the width
15   between the lines ~~having~~being three pixels. A background color
of white causes a miosis and a greater depth of field in the
eyes due to its excessive brightness, thus ~~raising~~causing a
problem of providing reduced difference in the ~~way~~viewing of
~~viewing~~the four zones. This is why the eye-friendly green
20   base color is used to reduce brightness. ~~A color of black~~Black
was ~~employed~~used as the color of the lines because a number of
subjects who underwent an eye examination experiment
determined consequently that black could be easily viewed. The
width of the lines ~~has~~is at least two pixels because
25   particularly in the case of a CRT display, one pixel may

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provide a different viewing between the horizontal/vertical
and the diagonal direction due to the occurrence of focus
blurring caused by the electron gun. The width between the
lines was ~~so~~ set such that the spacing between the lines could
5   be recognized from a distance of 1m because an extremely short
distance to the chart in the astigmatism measurement would
invert the astigmatic axis by 90 degrees, possibly resulting
in an error in the measurement. A vision of 1.0 (an angle of
view of 0.1 degrees) indicates the capability of
10 distinguishing a slit of 0.29mm at a distance of 1m, which
generally corresponds to one pixel on a 14-inch liquid crystal
display or a 17-inch CRT. Therefore, two pixels correspond to
a vision of about 0.5. However, since those who take the eye
test need spectacles, the spacing was further expanded to ~~have~~
15 three pixels.

On the other hand, the four orientations were provided
for the astigmatic axis because of the following reasons. That
is, this makes it possible to select sufficiently practical
spectacles or contact lenses even using the four orientations,
20 and the determination needs to be made as easily as possible
without any error because the subject makes the determination
by himself or herself.

Then, to measure the far point vision in the selected
orientation that has been selected by the subject, the
25 procedure displays the vision measurement chart for the

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selected orientation (S18) to acquire the viewing limit
selected by the subject, which is then stored as first viewing
limit data (S20). Fig. 67 is an explanatory view illustrating
an example of a screen for a far point vision measurement, Fig.
5   68 showing an example of the far point vision measurement
screen.

    As illustrated, the vision measurement chart is a light
and dark line image made up of three black lines and two white
lines of a certain line width, a plurality of the charts being
10 displayed in each of which the width of the lines are varied
in I steps (from about 10 steps to 20 steps) corresponding to
vision. On the vision measurement charts, the subject is
instructed to click on the smallest mark that the subject can
distinguish the three lines. Since the subject is
15 ~~allowed~~permitted to select the mark that provides the viewing
of three lines as described above, the subject can make a
determination more easily ~~when~~as compared ~~with~~to the Landoldt
ring that is viewed to visually distinguish a single gap.

    The subject is instructed to measure the far point vision
20 at a reach from the computer screen. This is because the
length of the arm is proportional in length to the height, and
thus the distance between the subject and the chart can be
predicted in accordance with the data on the height entered in
advance.

25 As described above, the measurement can be conveniently

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carried out because the subject does not need to measure the
distance to the computer screen or adjust the screen display
size.

Likewise, to measure the far point vision in the
orientation perpendicular to the ~~selected~~ orientation selected
by the subject, the procedure displays the vision measurement
chart in the orientation perpendicular to the selected
orientation (S22), and the viewing limit selected by the
subject is acquired and stored as second viewing limit data
(S24).

Then, to measure the near point distance in the
orientation selected by the subject, the procedure displays a
near point distance measurement chart in the selected
orientation (S26) to store the near point distance entered by
the subject as the first near point distance data (S28). Fig.
69 is an explanatory view illustrating an example of a screen
for a near point distance measurement, Fig. 70 ~~showing~~ shows an
example of the near point measurement screen.

As illustrated, the near point distance measurement chart
has three black lines provided ~~in~~ on a green background. The
message on the screen instructs first the subject to move as
close to the screen as possible and then move away therefrom
to a position at which the subject can clearly see the three
lines and measures the distance between the eyes and the
screen, thereafter instructing the subject to input the

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distance in centimeters.

The near point distance measurement chart ~~employs~~uses thinner lines as compared ~~with~~to the aforementioned vision measurement chart regardless of vision of a subject, because the chart is viewed in close proximity to the computer screen. However, because of the difference in resolution due to ~~the~~ age, thin lines are used for ~~the youth~~youths and slightly bolder lines are used for ~~the~~middle-aged and ~~the~~elderly people.

To measure the near point distance in the orientation perpendicular to the selected orientation selected by the subject, the procedure displays a near point distance measurement chart in the selected orientation (S30) to store the near point distance entered by the subject as the second near point distance data (S32).

Then, the procedure determines the far point distance from the first viewing limit data, the first near point distance data, and the subject limit data to store the resulting distance as the first far point distance data (S34). Likewise, the procedure determines the far point distance from the second viewing limit data, the second near point distance data, and the subject limit data to store the resulting distance as the second far point distance data (S36).

The far point distance is ~~operated~~measured using a neural network ~~that~~which a number of subjects have taught in

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advance. Fig. 71 is a view illustrating an exemplary
configuration of a neural network for operating the far point
distance. As illustrated, the input layer has I steps of far
point vision (the viewing limit selected by the subject on the
vision measurement chart), J steps of near point distance (the
near point distance measured by the subject on the near point
distance measurement chart), and K steps of subject attributes
(the age, the gender, and the height), while the output layer
has N steps of far point distance. The age and gender are
~~employed~~used as parameters because the accommodation ability
of the eyes of the subject ~~is varied due to them.~~varies
depending upon age and gender. The height, as described above,
~~that~~which is proportional to the length of the arm, is used as
a substitute parameter in order to adjust the distance between
the subject and the screen to the length of the arm. As the
method of learning, ~~employed is~~ the ~~so-called~~ back-propagation
method~~, but~~ is used. However, the method is not limited
thereto.

Here, to make the conversion into the lens power easier,
the near point distance of the input parameters and the far
point distance resulted from the operation are each converted
~~for handling~~ to the value D (diopter) or the reciprocal of the
distance measured in meters.

The neural network was designed to produce two
independent learning models in the selected orientation of the

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astigmatic axis and the orientation perpendicular to the
selected orientation to perform calculations for each of them
separately.

   Since different types of displays provide different ways
5 of viewing the screens, the operation was performed using
neural networks that had been separately taught depending upon
the display being either ~~the~~a liquid crystal display or ~~the~~a
CRT.

   The astigmatic axis determination (S14) through the far
10 point distance calculation (S36) described above are performed
for both eyes, right and left eyes, so as to calculate
diopters (S: spherical diopter, C: ~~cylinderical~~cylindrical
diopter and AX: axis of astigmatism) from the obtained
selected direction data, the first far point distance data,
15 and the second far point distance data (S38).

   Assuming that the first far point distance obtained at
S34 is D1, its direction is AX1, the second far point distance
obtained at S36 is D2 and its direction is AX2,
when $|D1| < |D2|$, S = D1, C = D2 - D1, AX = AX1, and
20 when $|D2| < |D1|$, S = D2, C = D1 - D2, AX = AX2.

   Although the case where a diopter of the eye is merely
calculated is described in the above-described preferred
embodiment, a diopter of a lens may be determined from the
obtained diopter of the eye and the wearing conditions in the
25 subject attribute data so as to accept an order of spectacles

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or contact lenses.

In this case, based on the wearing condition in the subject attribute data, a distance for which the spectacles or contact lenses are normally used is determined from any one of

5 short-distance use (30 cm), intermediate-distance use (50 to 60 cm) and long-distance use (5 m) so as to determine a diopter of a recommended lens.

For example, for long-distance use, the far point distance D1 is corrected to be 5 m (-0.2 D). Therefore, a

10 diopter of a recommended lens is D1 + 0.2 D.

~~Eyeball~~An eyeball optical model generating ~~means~~unit for generating an eyeball optical model based on the lens power calculated by the lens power calculation ~~means~~unit and the attributes of the subject and a_naked eye focal performance

15 confirmation ~~means~~unit for confirming focal performance of a naked eye by using the generated eyeball optical model may be provided so as to check the validity of the calculated lens power. As a result, a lens power can be determined with higher accuracy.

20 Moreover, a_post-correction focal performance calculation ~~means~~unit for calculating focal performance after vision correction with a recommended lens by using the generated eyeball optical model may be provided so as to determine the recommended lens. As a result, a lens power more suitable ~~to~~

25 for_the subject may be ~~presented~~provided.

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Furthermore, a sharpness score calculation ~~means~~unit for calculating a sharpness score at a predetermined distance from a focal state with the recommended lens, an image sample generating ~~means~~unit for generating an image sample at the

5   calculated sharpness score, and an image sample display ~~means~~unit for displaying the generated image sample on the computer screen are provided ~~so~~such that the subject confirms the image sample with the recommended lens on. As a result, since the subject can check how well he/she can see with the

10   lenses on, a more suitable a lens power ~~can be decided~~is provided.

Although ~~it is described that~~ the far point distance calculation ~~means uses a~~unit using a neural network that learns from a large number of subjects to obtain the far point

15   distance from the far point vision, the near point distance, and the attributes of the subject is described, the present invention is not limited thereto. The far point distance may be calculated by using a fuzzy inference so as to obtain a membership function or an inference rule from the data of a

20   large number of subjects. Moreover, from the data of a large number of subjects, the ~~relation~~relationship between the far point vision and the far point distance may be obtained as an approximate formula including the near point distance and the attributes of the subject as parameters so as to be used to

25   calculate the far point distance. In this manner, the

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~~effects~~advantages of the present invention can be obtained.

Although the near point distance serves as an input parameter in the calculation of the far point distance in the above-described preferred embodiment, the present invention is

5   not limited thereto. The near point distance may be omitted. In this case, since the near point distance is ~~characteristic in being~~ proportional to the age, the ~~effects~~advantages of the present invention can also be obtained.

Although it is described that the linear groups in four

10   directions, each ~~being formed by~~including a plurality of parallel lines, are displayed on one screen in the astigmatism axis determination chart ~~so~~such that the subject selects the zone that appears dissimilar in the above-described preferred embodiment, the present invention is not limited thereto. The

15   linear groups in four directions may be individually displayed in a sequential manner so as to select the direction in which the zone appears dissimilar.

Although a plurality of charts, each being different in size, are arranged and displayed on one screen in the vision

20   test chart ~~so~~such that the subject selects the limit of visibility in the above-described preferred embodiment, the present invention is not limited thereto. The charts in the respective sizes may be displayed in ~~the larger~~size order ~~so~~such that the limit of visibility is chosen by the subject.

25   Although the images of the selected direction in the

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astigmatism axis determination and the direction
perpendicularly crossing it are displayed on the computer
screen for the display of the vision test chart and the near
point distance measurement chart in the above-described
preferred embodiment, the present invention is not limited
thereto. The images of four directions may be stored in the
display screen database 6030 in advance ~~so~~such that the image
is selected therefrom for display. Alternatively, image data
for a specific direction may be stored, whereas the images of
the other directions may be generated by rotating the image
with a graphic tool based on the direction data. Moreover,
graphic data of the image to be displayed may be stored ~~so~~such
that the images are drawn and generated by a drawing tool
based on the direction data. As described above, by using a
method of generating images by a graphic tool, a load on the
image display is increased. However, since an image in an
~~arbitral~~arbitrary direction can be generated, a direction of
the axis of astigmatism may be ~~easily extended~~determined more
accurately.

    Similarly, for the display of a plurality of charts with
varied line widths in the far point vision test, image data
with a specific line width may be enlarged and reduced by a
graphic tool or may be drawn and generated by a graphic tool.

    Although it is described that the display size of the
astigmatism axis determination chart, the vision test chart,

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and the near point measurement chart on the screen is not
particularly changed by the computer settings in the above-
described preferred embodiment, the present invention is not
limited thereto. In order to obtain a lens power with higher
accuracy, the screen settings of the computer may be acquired
so as to change the display size of the screen based on them.
The screen settings of the computer to be obtained are the
type and the size of a display, the resolution settings of a
computer, and the like.other relevant parameters. They may be
automatically obtained from property information of the
computer or may be input as the subject attribute data.

     As described above, images may also be enlarged or
reduced by a graphic tool or may be drawn by a drawing tool in
this case.

     Furthermore, although it is described that an
experimentally determined optimal color is used as a display
color of the astigmatism axis determination chart, the vision
test chart, or the near point distance measurement chart in
the above-described preferred embodiment, the present
invention is not limited thereto. A display color selecting
function may be provided.

     For example, color samples may be displayed in advance to
the subject so-such that the subject can select the color that
he/she likes, or a predefined color may be automatically
selected by screen settingsettings of the computer for-display.

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Also for a display color of each of the charts, a plurality of display color patterns may be stored in advance ~~so~~ such that a selection can be made therefrom. It is apparent that an image in a specific display color pattern may be

5   color-converted by a graphic tool or may be drawn by a drawing tool.

Similarly, although it is described that an experimentally defined optimal brightness is used for a brightness of a background or a segment of the astigmatism

10 axis determination chart, the vision test chart, and the near point measurement chart in the above-described preferred embodiment, the present invention is not limited thereto. A display brightness selecting function may be provided.

Also for a display brightness of each of the charts, a

15 plurality of display brightness patterns may be stored in advance ~~so~~ such that a selection can be made therefrom. It is apparent that an image in a specific display brightness pattern may be brightness-converted by a graphic tool or may be drawn by a drawing tool.

20 Although it is described that the attribute data of the subject is acquired each time the subject receives an optometry service in the above-described preferred embodiment, the present invention is not limited thereto. It is apparent that the attribute data ~~is~~may be pre-stored as a customer

25 database ~~so~~ such that necessary data is extracted from the

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database. As described above, the customer database is
provided so as to store a history of the optometry services
provided ~~so~~thus far and data of sold spectacles and contact
lenses in addition to the subject attribute data described
5 above. As a result, more accurate optometry in accordance with
the characteristics of the subject can be ~~carried out~~performed
so as to ~~present~~provide more ~~proper~~accurate corrective lenses.

   It is described that the eye examination is carried out
~~mainly~~primarily for short-sighted persons who are also
10 astigmatic in the above-described preferred embodiment.
However, since the near point distance is obtained in addition
to the far point distance in this preferred embodiment, the
eye examination may also be ~~carried out~~ used for subjects who
are ~~long-~~farsighted or ~~presbyope based on it~~presbyopic.

15   More specifically, if the far point distance is extremely
long and the near point distance is also long~~too~~, there is a
possibility that he/she may be ~~long-~~farsighted or
~~presbyope.~~presbyopic. If the accommodation ability of eyes of
the subject is obtained, the determination of
20 ~~longsightedness~~farsightedness or presbyopia can be made based
on it.

   Therefore, for example, the age or gender of the subject
is used as a substitute parameter for the accommodation
ability of eyes. A neural network, which uses the far point
25 distance, the near point distance, and the attributes of the

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subject (age and gender) as inputs and outputs the diopter of astigmatism and the diopter of long-sightedness, is made to learn a large number of subjects who are ~~long~~ farsighted or ~~presbyope.~~ presbyopic. By using it, the diopter of ~~long~~

5   farsightedness or presbyopia may also be calculated.

Moreover, the accommodation ability of eyes of the subject may be actively measured by using a computer screen so as to determine the diopter of ~~long~~ farsightedness or presbyopia based on it. For this determination, for example, a

10   method of measuring the tracking ability of an image traveling on the computer screen, measuring the visibility when the subject moves changing a distance with the computer screen in a rapid cycle ~~or the like~~ is conceivable. In this manner, not only short-sighted persons who are also astigmatic but also

15   subjects who are ~~long-sighted or presbyope may be dealt with.~~ farsighted or presbyopic may use the system. Therefore, an optometry system for everybody ~~can be constructed~~ is obtained.

According to preferred embodiments of the present

20   invention, the attributes of the subject are obtained. In addition, the astigmatic axis determination chart is displayed on the computer screen so as to obtain the direction selected by the subject. The vision test chart is displayed for the obtained direction and the direction perpendicularly crossing

25   it so as to obtain the limit of visibility selected by the

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subject. The far point distances are calculated from the
obtained limit of visibility and the obtained attributes of
the subject so as to calculate the lens power from the
obtained direction and two calculated far point distances.
5   Therefore, the present invention is effective in that the
subjects who are astigmatic can be dealt with and the eye
examination can be ~~carried out~~performed in a simple manner by
using the computer screen without requiring any special
equipment.

10   Next, a third preferred embodiment of the lens power
deciding step described above will be described by using a
lens power deciding system shown in Fig. 72. The lens power
deciding system is for constructing an optical model of an
eyeball of the user to decide a power of a corrective lens,
15   and includes a central processing unit 8012. The central
processing unit 8012 controls the operations of: a data input
section 8014; an input data check section 8016; a far point
distance calculating section 8018; a start eyeball optical
model deciding section 8020; an eyeball optical model focal
20   performance calculating section 8022; a model validity
examining section 8024; an eyeball optical dimensions-
accommodation range determining section 8026; an eyeball
optical model deciding section 8028; a viewed image generating
section 8030; a sharpness score generating section 8032; and a
25   display section 8036. Hereinafter, the schema of each of the

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sections controlled by a central control unit 12 will be described.

The data input section 8014 is for inputting the age of a person who wants to wear corrective lenses, such as spectacles or contact lenses, the conditions of use of the corrective lenses, the axis of astigmatism, the far point vision, and the near point distance. The data input section 8014 ~~is composed of~~ includes equipment such as a keyboard, a mouse, or a touch panel to which a person directly inputs data or equipment configured to be able to receive data through a network by using a modem~~,~~ or a LAN card, ~~or the like,~~ and a program for controlling the equipment.

The far point vision in this preferred embodiment does not mean a generally used power unit such as 1.5, but rather, another numerical unit. Hereinafter, the far point vision will be described in detail. On a display such as a computer, targets as shown in Fig. 73 are displayed. The subject ~~perfectly stretches out~~ fully extends his/her arms while touching a display with fingers. He/she ~~perfectly stretches out~~ fully extends the arms with the ~~ramrod~~ straight posture. In this state, the targets for measuring ~~a~~ vision are sequentially displayed in the ~~larger~~ order of size on the display as shown in Figs. 73(a) to 73(c). The subject selects the smallest one of the displayed targets, of which black three lines can be clearly seen. The number assigned to the

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target selected by the subject is determined as the far point vision. The far point distance ~~can be~~ is calculated from the far point vision.

The input data check section 8016 checks the consistency of the input value from a value of the data input to the data input section 8014. The input data check section 8016 stores therein a large amount of stored standard sample data 8016a in which data of the axis of astigmatism, the far point distance, and the near point distance are associated with each other on the basis of ~~the~~ age. The input data check section 8016 determines whether a value of the data input to the data input section 8014 is valid as a result of comparison with the standard sample data 16a.

The far point distance calculating section 8018 calculates the far point distance from the far point vision corresponding to the data input to the data input section 8014. The far point distance calculating section 8018 stores data related to age, gender, height, far point vision, and the near point distance. Based on the input data of age, gender, height, far point vision, and near point distance, the far point distance calculating section 18 calculates the best far point distance that is the most suitable to the data.

The start eyeball optical model deciding section 8020 decides a start eyeball optical model based on the age of the subject and the approximated lens power.

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Now, the eyeball optical model will be explained below. In the eyeball optical model, light-beam refractive elements of a human eye, as shown in Fig. 74, are configured as ~~an~~ a mathematical/physical numerical model ~~as~~ of a lens. As shown in Fig. 74, the eyeball optical model ~~comprises~~includes light-ray refractive elements of the eyeball such as the cornea, the anterior chamber, the lens of the eye, ~~and~~ the vitreous body, and the retina. An eyeball optical model is constructed with respect to these light-beam refractive elements in accordance with the following optical dimensions.

Cornea: the radius of curvature R3 of the front surface, the thickness, the refractive index, and the radius of curvature R4 of the rear surface

Anterior chamber: the thickness and the refractive index

Lens of the eye: the radius of curvature of anterior cortex (the radii of curvature R5, R6, R7, R8, R9, and R12) and the thickness of the anterior cortex; the radius of curvature of nucleoplasm (the radii of curvature R13, R14, R15, R16, R17, R18, R19, R20, R21, R22, R23, R24) and the thickness of the nucleoplasm; and the radius of curvature of posterior cortex (the radii of curvature R25, R26, R27, R28, R29, R30, R31, R32, and R33) and the thickness of the posterior cortex and their respective refractive indices

Vitreous body: the refractive index and the thickness

Retina: Radius of curvature R34

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The aforementioned optical dimensions are different from each other depending on the age and the accommodation ability of the eye of each individual. However, in this preferred embodiment, an eyeball optical model is pre-constructed as a standard pattern with reference to values from living body measurement data on Japanese people. For example, regarding the anterior chamber,

Depth of anterior chamber: the depth of anterior chamber is 3.66mm for the ages of 8-15, 3.71mm for the ages of 16-30, 3.51mm for the ages of 31-51, 3.18mm for the ages of 51-77.

Length of the eye axis: the length of the eye axis shows a tendency contrary to the aging tendency of the depth of anterior chamber.

Lens of the eye: there is uneven distribution of refractive indices. The refractive index of the surface is irrelevant to age, but the refractive index of the nucleus of the lens of the eye increases a little by aging. The weight of thickness increased by aging is 174mg for the ages of 20-39, 204mg for the ages of 40-59, and 266mg for the ages of 80-99.

Although the eyeball optical model is constructed based on the aforementioned values in this preferred embodiment, the eyeball optical model may also be constructed based on the values listed in the literature data. The following is an example of literature data applicable to the construction of an eyeball optical model.

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(i) Concerning the depth of the anterior chamber

According to "Study on the depth of anterior chamber" by Katsuo Aizawa, Japanese Ophthalmological Society Journal Vol. 62, No. 11 (1958), the relationship between the depth of the anterior chamber and the age varies as follows:

3.66mm for ages from 8 to 15,

3.71mm for ages from 16 to 30,

3.51mm for ages from 31 to 51, and

3.18mm for ages from 51 to 77.

That is, the study ~~tells~~ indicates that the depth of the anterior chamber tends to gradually increase as the body grows from the youth and reach the maximum level when the body has grown up, and thereafter, gradually decrease as the body deteriorates.

(ii) Concerning the length of the eye axis

According to "Study No. 1 on the essence of shortsightedness" by Tsutomu Sato, et al, Japanese Ophthalmological Society Journal Vol. 63, No. 7 (1959), for the low degree of shortsightedness, the length of the eye axis gradually increases as the degree of myopia ~~becomes higher~~ increases, showing a strong correlation therebetween.

(iii) Concerning the weight of the lens of the eye

According to "The eye" by Davson Hugh (1909-) and Graham L.T. Jr., New York; London Academic Press, the weight of the lens of the eye only increases with advancing age as follows:

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174mg for ages from 20 to 39,

204mg for ages from 40 to 59, and

266mg for ages from 80 to 99.

(iv) Concerning the thickness and diameter of the lens of the

5 eye

According to Complete Collection of New Clinical Ophthalmology 3A, by Hiroshi Ichikawa, et al, 1993, KANEHARA & CO., LTD, the thickness and diameter of the lens of the eye increases with advancing age.

10 The eyeball optical model that has been pre-constructed by applying the aforementioned values is used as the start eyeball optical model determined by the start eyeball optical model deciding section 8020. The start eyeball optical model is not constructed for the combinations of all ages and

15 approximate lens powers, but with attention being given to the fact that the start eyeball optical model has ~~generally~~ common eye characteristics for the same age and approximate lens power, such an eyeball optical model is pre-constructed~~, which has~~ to have a median value in each age class represented on

20 the vertical axis and a median value in each approximate lens power class represented on the horizontal axis. The vertical axis representing M classes and the horizontal axis representing N classes allow for constructing M by N start eyeball optical models. That is, ~~employed is~~ a table is used

25 in which the vertical axis represents the age class (e.g., at

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five year intervals up to twenty years of age, and at 10 year
intervals for 20 years of age or more) and the horizontal axis
represents the approximate lens power (e.g., at intervals of
1.0D). With this table, such a start eyeball optical model is
5   pre-constructed ~~at~~ for a combination of median values in each
class (e.g., the 35 years of age and the lens power of the
amount of correction required being -2.5D).

Although M × N eyeball optical models are constructed as
start eyeball optical models~~. Among them,~~ and the start
10   eyeball optical model deciding section 8020 uses the eyeball
optical model having the closest value as a start eyeball
optical model ~~although~~among them in this preferred embodiment,
it is not limited thereto. A start eyeball optical model may
be constructed from the values of the constructed eyeball
15   optical models based on the most suitable value of a light-
beam refractive element from the measured age and approximated
lens power.

The start eyeball optical model ~~decided~~determined in the
start eyeball optical model deciding section 8020 is used as
20   an initial value in the eyeball optical model deciding section
8028 described below to perform an optical system design
automation process for constructing an eyeball optical model
~~proper to~~that is accurate for the person. In this start
eyeball optical model, the design automation process is
25   terminated within a short time, and therefore, the processing

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~~speed can be~~ time is reduced as compared with an optical system design automation process using an independent start eyeball optical model which is not based on the age or the approximated lens power. Moreover, the reliability of

5   solutions (optical dimensions enabling the best focal state) is ~~high~~improved.

The eyeball optical model focal performance calculating section 8022 calculates focal performance of the eyeball optical model in a naked eye state of the subject or with

10   corrective lenses. As a state of the eyeball for calculating a focal state, ~~there is~~ a state at the near point or the position within the range of accommodation ability in the vicinity of the near point, a state at the far point or the position within the range of accommodation ability in the

15   vicinity of the far point, or a state at the position away from the near point and the far point is used.

The model validity examining section 8024 examines the validity of the eyeball optical model at the limit of accommodation on the near point side and/or on the far point

20   side based on the focal performance calculated by the eyeball optical model focal performance calculating section 8022.

The eyeball optical dimensions-accommodation range determining section 8026 determines the range of accommodation of the eyeball at an accommodation midpoint from the input

25   near point distance and the calculated far point distance.

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Furthermore, the eyeball optical dimensions-accommodation range determining section 8026 is configured to generate an image of the eyeball optical model in which the range of accommodation of the eyeball at the accommodation midpoint is

5   determined.

The eyeball optical model deciding section 8028 adjusts the values of the optical dimensions of the start eyeball optical model ~~so~~such that the focal state in the eyeball of the subject at the midpoint of accommodation calculated from

10   the near point distance and the far point distance of the subject ~~becomes~~is optimal, thereby ~~deciding~~determining the eyeball optical model ~~fitted~~that corresponds to a state of the eye of each person.

The viewed image generating section 8030 generates visual

15   images viewed by the subject before and/or after the correction by ~~means~~unit of a corrective lens based on the result calculated in the eyeball optical model focal performance calculating section.

The sharpness score generating section 8032 derives the

20   sharpness score that indicates mathematically the degree of sharpness of viewing by the subject before and/or after the correction by ~~means~~unit of a corrective lens.

The sharpness score indicates how sharply an image is viewed in an arbitrary numerical value and is calculated, for

25   example, ~~so~~such that the higher numerical value indicates that

the image is more sharply seen.

The lens power selecting section 8034 examines optical performance when the subject wears spectacles or contact lenses to select a lens power.

The display section 8036 is a display device for confirming an ~~operation~~operating condition of a corrective lens deciding server 8010 or for confirming a value of the data input by the subject or the calculated data. As the display section 8036, a display connected to the computer or a display of the computer connected to the corrective lens deciding server 8010 via the data input section 8014 is used.

Next, an operation of the present invention will be described with reference to Fig. 75.

(1) The gender, the age, the axis of astigmatism, the near point distance, the far point vision, and the conditions of use of corrective lenses (for reading, deskwork, driving, and the like) of the subject are input by using the data input section 8014.

(2) The input data is examined by the input data check section 8016.

(3) The far point distance is calculated from the far point vision by the far point distance calculating section 8018.

(4) By using a relational table of the range of accommodation in terms of age, supposing an average range of

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accommodation at an assumed age, eyeball

~~refractivies~~refractive values at the upper limit and the lower

limit of the range of accommodation are derived. Based on them,

the near point distance and the far point distance are

5   corrected.

(5) A midpoint in the range of accommodation of the eyes

of the subject is obtained from the near point distance and

the far point distance. Furthermore, the approximated lens

power is calculated.

10   (6) A start eyeball optical model is ~~decided~~selected by

the start eyeball optical model deciding section 8020 from the

age and the value of the approximated lens power.

(7) The focal performance is calculated by the eyeball

optical model focal performance calculating section 8022 using

15   the ~~decided~~selected start eyeball optical model. The ultimate

eyeball optical model in an intermediate state of the

accommodating function of the eyes is ~~decided~~determined by the

eyeball optical model deciding section 8028. More specifically,

a light beam is ~~incident~~directed on the eyeball optical model

20   in the accommodation midpoint state by the eyeball optical

model focal performance calculating section 8022 so as to

calculate the focal performance of the light beam on a retina.

The optical system design automation process is performed to

achieve the best focal state. The optical dimensions are

25   changed by the eyeball optical model deciding section 8028 to

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determine optimal solutions (optical dimensions). In the
construction of the eyeball optical model at the accommodation
midpoint, the automatic optical design calculation begins with
the aforementioned start eyeball optical model to
5   automatically determine the optical dimensions of a human
eyeball so as to provide the optimal focal performance.

        As used herein, the automatic optical design calculation
refers to the automatic process for determining optical
dimensions by light beam tracking using an automatic lens
10   design program. As a typical example of these techniques, the
dumped least squares method is available.

        The calculation minimizes the sum of squares of the
amount of deviation in position from the point of arrival of
light on the retina while the values of the optical dimensions
15   of the eyeball optical model are being gradually varied (a
radius of curvature and an intervals of surfaces are varied
while a refractive index is unchanged; in the case of non-
spherical surface, a radius of curvature of reference
spherical surface and aspherical surface coefficient are
20   varied) to satisfy a final performance condition (in this
preferred embodiment, a focal state in which the cases where a
plurality of beams of light are impinged from an infinitesimal
point object located in the accommodation midpoint condition
upon the pupil diameter (e.g., φ =3mm) of the eyeball optical
25   model at various heights of incidence are calculated to track

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the refraction change of beams of light, thereby allowed to focus onto a point on the retina). This is the same as in an "eyeball optical model construction process of a person at the midpoint of accommodation" described below.

5   (8) The model validity examining section 8024 is used to check the validity of the eyeball optical model at the accommodation limit (on the near point side). In this validity check, the eyeball refractive power is ~~brought up~~increased (UP) by the amount of accommodation ability of a human eyeball,

10   and then the automatic optical design calculation is performed to confirm a good focal performance.

As used herein, the "~~bringing up~~increasing (UP) the eyeball refractive power by the amount of accommodation ability" ~~means as follows.~~performs the following operations.

15   Assuming that the far point distance is 1m (-1.0D) and the near point distance is 25cm (-4.0D), the accommodation midpoint position is 40cm (-2.5D) and an UP in the eyeball refractive power corresponding to the amount of correction of -1.5D is required on the near point side with respect to the

20   accommodation midpoint position. As described above, an increase in eyeball refractive power corresponding to this -1.5D is provided as follows. While the boundary conditions for the automatic optical design are being controlled, a plurality of beams of light are ~~impinged~~directed from an infinitesimal

25   point object located at a near point distance of 25cm upon the

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pupil diameter (e.g., φ =3mm) of the eyeball optical model at various heights of incidence to track the beams of light. Thus, the automatic optical design is performed while the optical dimensions are being varied so as to focus the beams of light

5   on a point on the retina.

Suppose that this has conceivably resulted in the convergence of the light on one point. In this case, it is determined that the optical model has been successfully simulated at the accommodation limit, and the eyeball optical

10   model of the subject is valid at the accommodation midpoint.

(9) The model validity examining section 8024 checks the validity of the eyeball optical model at the accommodation limit (on the far point side). In the validity check, the eyeball refractive power is ~~brought down~~decreased (DOWN) by

15   the amount of accommodation ability of a human eyeball, and then the automatic optical design calculation is performed to confirm ~~a~~ good focal performance.

As used herein, the "~~bringing down~~decreasing (DOWN) the eyeball refractive power by the amount of accommodation

20   ability" ~~means as follows.~~

—————performs the following operations. Assuming that the far point distance is 1m (-1.0D) and the near point distance is 25cm (-4.0D), the accommodation midpoint position is 40cm (-2.5D) and a DOWN in the eyeball refractive power corresponding

25   to the amount of correction of +1.5D is required on the far

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point side with respect to the accommodation midpoint position.
As described above, a decrease in eyeball refractive power
corresponding to this +1.5D is provided as follows. The
boundary conditions for the automatic optical design ~~are being~~

5   controlled, a plurality of beams of light are ~~impinged~~directed
from an infinitesimal point object located at a far point
distance of 1m upon the pupil diameter (e.g., φ =3mm) of the
eyeball optical model at various heights of incidence to track
the beams of light. Thus, the automatic optical design is

10 performed while the optical dimensions are ~~being~~ varied so as
to focus the beams of light on a point on the retina.

Suppose that this has ~~conceivably~~ resulted in the
convergence of the light on one point. In this case, it is
determined that the optical model has been successfully

15 simulated at the accommodation limit, and the eyeball optical
model of the subject is valid at the accommodation midpoint.

(10) The model validity examining section 8024 checks the
validity of the eyeball optical model outside the
accommodation limits on the near and far point sides, i.e.,

20 outside the range of accommodation of the eyeball.

(11) The eyeball optical dimensions-accommodation range
determining section 8026 finally determines the range of
accommodation of the eyeball optical dimensions for the
eyeball optical model at the accommodation midpoint position.

25 (12) An image of the decided eyeball optical model, for

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example, a cross-sectional view of an eyeball as shown in Fig.
74 is generated by the eyeball optical dimensions-
accommodation range determining section 8026. The description
for the eyeball optical model may be displayed therewith.

5   (13) The focal performance with the accommodation at
three distances in a naked eye state of the subject is
calculated by the eyeball optical model focal performance
calculating section 8022.

The eyeball optical model at the accommodation midpoint
10   position and the range of accommodation of the optical
dimensions are determined as follows.

The model validity examining section 8024 performs the
processing for checking the validity of the eyeball optical
model at the accommodation limit (on the near point side) and
15   the model validity examining section 8024 performs the
processing for checking the validity of the eyeball optical
model at the accommodation limit (on the far point side).
These checks determine, as a result of the processing for
constructing an eyeball optical model of the person at the
20   accommodation midpoint, that the eyeball optical model is
valid at the accommodation midpoint position. The eyeball
optical model is then used in the focal performance
calculation processing, discussed later, which is accompanied
by accommodation at the three distances with the eye
25   uncorrected, and the focal performance calculation processing

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which is accompanied by accommodation at the three distances
with the eye corrected. "The three distances" ~~is~~ are chosen
such that the viewed image is ~~possibly~~substantially changed~~-
remarkably~~, e.g. 0.3m (for reading), 0.5m - 0.6m (for

5   deskwork), and 5m (for car driving). ~~It can be said that the~~
The range of changes in optical dimensions at the
accommodation limits (in particular, the range of changes in
thickness of the lens of the eye within which the lens of the
eye is made thinner or thicker, in the radius of curvature of

10   the front surface, and in the radius of curvature of the rear
surface) has also been determined by the model validity
examining section 8024 performing the processing for checking
the validity of the eyeball optical model at the accommodation
limit ~~(on the near point side) and the model validity~~

15   ~~examining section 8024 performing the processing for checking~~
~~the validity~~. The determination of the range of ~~the eyeball~~
~~optical model at the accommodation limit (on the far point~~
~~side). The determination of them makes it possible to simulate~~
~~the~~ changes enables simulation of the accommodation of the eye

20   according to the distance to an object. The amount of an
increase (UP) or a decrease (DOWN) in eyeball refractive power
from the accommodation midpoint position is determined
according to the distance to an object to perform the
automatic optical design while the boundary conditions are

25   ~~being~~ controlled, ~~like~~ similar to the processing of the model

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validity examining section 8024 for checking the validity of
eyeball optical model at the accommodation limit (on the far
distance side).

The optical dimensions determined as described above
represent the condition of the eye in which the eyeball
virtually performs focus accommodation.

The calculation is repeated until no more improvement ~~can~~
~~be~~ is made in focal performance, and the resulting optical
dimensions are determined as the best focal performance at the
distance to the object.

To evaluate the focal performance, several hundreds of
beams of light equally dispersed are ~~impinged~~ directed from an
infinitesimal point object located at a certain distance upon
the pupil diameter (e.g., φ =3mm) of the eyeball optical model
to track the beams of light, thereby calculating where the
beams of light are focused on the retina. To evaluate the
degree of blurring, ~~the~~ a two-dimensional Fourier transform is
performed on the intensity distribution of a point image on
the retina, thereby calculating the spatial frequency
characteristics (OTF) to evaluate the image.

(14) The focal performance with the accommodation at
three distances described above for the optical model after
vision correction with corrective lenses is calculated and
examined by the eyeball optical model focal performance
calculating section 8022.

That is, an actual spectacle lens (with known radii of curvature of the front and rear surfaces of the lens and a known refractive index of the glass material) is placed in front of the eyeball optical model to perform a calculation

5   ~~like~~similar to the focal performance calculation processing with the eye uncorrected.

From the approximate lens power and the wearing conditions, an appropriate virtual lens is determined to perform an optical simulation on the focal performance with

10   the spectacle/contact lens being worn.

On the other hand, when the balance between the sharpness scores at the three distances ~~is badly kept~~unsatisfactory, the lens power is slightly varied to perform the optical simulation again.

15   (15) The sharpness score generating section 8032 is used to vary the optical dimensions of the eye within the range of accommodation ability to create the condition in which the focal performance is optimally provided, calculating the sharpness score at that time. The relationship between the

20   sharpness score and the viewed image is illustrated in Fig. 76. The sharpness score is calculated based on the ~~result~~results of focal condition calculated by the eyeball optical model focal performance calculating section 8022.

Several hundred~~s of~~ beams of light equally dispersed are

25   ~~impinged~~directed from an infinitesimal point object located at

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a certain distance upon the pupil diameter (e.g., φ =3mm) of the eyeball optical model to track the beams of light, thereby calculating where the beams of light are focused on the retina. A value obtained by ~~the~~ a two-dimensional Fourier transform

5   being performed on the intensity distribution of the point image is called the spatial frequency characteristics (OTF). Checking how the intensity is distributed on the retina ~~makes it possible to evaluate~~ enables evaluation of the degree of blurring. The spatial frequency is a value which represents

10 the fineness of a stripe pattern and is defined as the number of stripes per unit length.

For a visual system, ~~it~~ the spatial frequency is represented by the number of stripes per visual angle of 1 degree. For example, assuming that the spacing of the stripes

15 is w (degrees), ~~it~~ the spatial frequency is given that u=1/w (cycles/deg).

The value of w used for ~~the evaluation of~~ evaluating blurring is ~~found~~ determined from the resolution of the retina, ~~allowing~~ which enables the sharpness score to be calculated

20 based on the value of u provided at that time.

(16) The viewed image generating section 8030 is then used to generate and display visual images at the three distances before and after the correction with the recommended lens (Fig. 77). By this process~~ing~~, the user can confirm on

25 the screen the ~~ways of~~ viewing quality with the uncorrected

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eye and with the recommended lens being worn.

The viewed image generating section 8030 is used to prepare images at the three distances which are photographed at high resolution. Generation of the view images is performed

5 such that the N by N size smoothing filter processing is performed on these images pixel by pixel to blur the images ~~to blur the images~~. The degree of blurring ~~can be~~ is adjusted by the value of N (at a minimum of 3), filter weighting, and the number of processing times ~~of the processing~~. The spatial

10 frequency analysis is performed on the images that have been filtered in order to determine the degree of blurring, which is in turn associated with the sharpness score that has been determined through the calculation of the sharpness score.

Several images are prepared which correspond to ~~some~~the

15 sharpness scores. Furthermore, the score values are calculated ~~which~~ and correspond to the images obtained by the special smoothing filter processing being performed once on the prepared images.

The score value determined by the calculation of the

20 sharpness score is used to directly ~~call~~ display the corresponding image ~~for display~~ or to filter the ~~image to display the resulting~~ displayed image corresponding to its sharpness score.

(17) Furthermore, images showing the respective views at

25 three distances are presented for comparison by the viewed

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image generating section 8030 while replacing lens. More
specifically, a lens power is changed to perform an optical
simulation with spectacles or contact lenses on. Then, the
optical dimensions are changed within the range of

5   accommodation of the eyeball to ~~create a state where~~optimize
the focal performance~~is optimal~~. A sharpness score ~~at that~~
~~time is~~is then calculated.

If a sharpness score at a specific lens power has already
been calculated by the lens power selecting section 8034, ~~it~~

10   the sharpness score may be ~~configured to use~~obtained using
the data.

(18) The subject visually determines a corrective lens at
a corrective power that he/she desires from the displayed
viewed image and a sharpness score ~~so~~, such that the number~~,~~

15   and code ~~or~~of the ~~like indicating the~~desired corrective lens
to be used is selected by the data input section 8014.

As described above, this lens power deciding system
includes~~:~~ the input ~~means~~unit for inputting information
related to a state of the eyes of the user~~,~~, the eyeball

20   optical model deciding ~~means~~unit for deciding an eyeball
optical model in accordance with the information related to
the input state of the eyes~~,~~, the eyeball accommodation range
determination ~~means~~unit for examining optical performance of
the eyeball within the range of accommodation of the user in

25   the decided eyeball optical model to determine the range of

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accommodation of the eyeball~~,~~, and the lens power selecting ~~means~~unit for examining the optical performance when the user wears spectacles or contact lenses to select a lens power. Therefore, a lens power of spectacles or contact lenses fitted

5   to eyes of each person ~~can be decided~~is determined.

In the above description, the spectacle and contact lens selecting system, the spectacle virtual try-on system, and the remote subjective vision test system are described as independent spectacle order/sales centers, respectively. In

10   practice, however, they are integrated on a single computer or server to share the database, or they are integrated by performing a distributed processing with a plurality of computers or servers ~~so~~such that the user information, the frame selection information, the vision test information, and

15   ~~the like~~other relevant information are intercommunicated through a LAN and ~~the like.~~other suitable network. As a result, the user accesses from a single user client to a single site to receive a series of order/sales services of spectacles or contact lenses.

20   The lens power may be ~~decided~~determined by using a lens power obtained by the lens power deciding system or by using a lens power obtained by the optometry system.

Moreover, ~~owing~~due to the spectacle and contact lens selecting system obtained by the integration of the lens power

25   deciding function by the remote subjective vision test system,

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the lens power deciding system or the optometry system as
described above and the frame selecting function by the above-
described spectacle virtual try-on system, lenses fitted to
eyes of each person can be remotely selected. In addition, ~~a~~

5   ~~frame or the like~~frames can be selected after visual
confirmation of a wearing state of each person. Therefore, the
user is assured to receive the order/sales services of
spectacles or contact lenses through a network such as the
Internet.

10   Although the user client, the spectacle order/sales
center~~,~~ and the external payment transaction agency are
connected by the Internet in the above-described preferred
embodiment, the present invention is not limited thereto. ~~It~~
~~is apparent that they are~~ Alternatively, the spectacle

15 order/sales center and the external payment transaction agency
may be partially or entirely connected through a LAN~~,~~ or a WAN
~~or the like~~ within a specific organization. Moreover, the
present invention is not ~~necessarily~~ limited to the case where
the optometry service is provided for the subject through the

20 network. The spectacle and contact lens selecting system
according to the present invention may be installed in a store
~~or the like~~ to provide the order/sales service of spectacles
in a stand-alone fashion.

      Although the spectacle and contact lens selecting system
25 is described in the above ~~embodiment~~-described preferred

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embodiments, according to the spectacle and contact lens

selecting method including the respective ~~means~~unit in the

spectacle and contact lens selecting system of the present

invention as steps, the effects of the present invention can

5   be obtained independently of a hardware ~~structure~~configuration.

     Since the method of the present invention can be

~~realized~~achieved by a general-purpose personal computer, a

computer program describing the method of the present

invention in an executable manner in the personal computer may

10   be provided for the user so as to provide a selection service

of spectacles or contact lenses. It is apparent that the

computer program may be provided by a recording medium such as

a CD-ROM or may be provided for the user by downloading it

through the Internet or ~~the like~~other suitable network.

15

     As described above, according to the present invention,

easy selection of spectacles and contact lenses fitted to eyes

of each person ~~can be~~ is ensured.

     While the present invention has been described with

20   respect to preferred embodiments, it will be apparent to those

skilled in the art that the disclosed invention may be modified

in numerous ways and may assume many embodiments other than

those specifically set out and described above. Accordingly, it

is intended by the appended claims to cover all modifications

25   of the invention which fall within the true spirit and scope of

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the invention.